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ABSTRACT

This study sought to determine if there are relationships between student achievement and educational facilities. It focused on the question: Does school design influence the academic achievement of elementary school students? Criteria used were scores on the Iowa Test of Basic Skills and 86 variables describing design patterns in various categories such as movement patterns, large group spaces, architectural layout, daylighting and views, color, scale of building, and location of school site. Findings indicated that design does influence student learning, with circulation pattern or movement accounting for the largest percentage of variance for the third grade, and availability of large group meeting areas accounting for the largest percentage of variance in the fifth grade. (Contains 95 references.) (EV)

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THE RELATIONSHIP OF SCHOOL DESIGN TO ACADEMIC ACHIEVEMENT OF ELEMENTARY SCHOOL CHILDREN

by

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CHAPTER I

INTRODUCTION

Overview of the Problem

The conventional wisdom of superintendents and school board members is that educational facilities are only "containers" in which learning occurs. Educational decision-makers think that the design of these containers has little to add to the educational process. Contemporary thought about the learning process, however, places more emphasis on the pupil as the center of the learning process. Current educational trends also emphasize heuristic curricula that include a variety of objects and projects, which are essential to the discovery process. Hence, it may be time to rethink the idea that buildings are just containers; instead, facilities are true learning tools (Bingler, 1995).

This study was based on the premise that student learning and the physical environment are related. But, the physical environment of schools in America is questionable at best (Honeyman, 1998). Many schools require major repair or renovation, are inadequate to house the student population, and are unable to provide current modes of instruction. For example, Kozol's 1991 book, *Savage Inequalities*, discusses in detail the deplorable facilities in East St. Louis, Chicago, New York City, and Camden.

In another example, Lyons (1999) reported a 1989 survey estimating that there were 103,000 public primary and secondary school buildings in use. Almost half of these buildings (approximately 50,000) were constructed in the 1950's and 1960's. Roughly

30,000, or 29% of public schools, were built between 1970 and 1988. Approximately 23,000 (or 22%) were built prior to 1950 (Lyons, 1999).

Almost 30% of all school buildings are nearing the end of their useful life of 50 years (Honeyman, 1998). The average age of a public school facility is 42 years, and the mean age ranges from 37 years in the southeast to 46 years in the northeast and central states (National Center for Educational Statistics, 1999). Old schools have old designs, and many of them may not accommodate present and future curriculums. The combination of older facilities and increasing student populations requires new schools.

On average, two new K-12 school buildings are started each business day with the total cost nearing $16 billion per year (Lyons, 1999). In 1998, there was an unprecedented completion of school construction of educational facilities totaling $15.548 billion. This is nearly $3 billion more than the total completed in 1997. New facilities accounted for $7.893 billion, which is slightly more than 51%. The cost of additions was $3.897 billion, or approximately 25%. Just fewer than 24%, or $3.667 billion, was spent on the modernization of existing buildings (Abramson, 1999). An additional $17 billion was spent in construction starts during 1999 (Keller, 1999).

A recent report showed a 16% increase in spending for educational facilities from 1997 to 1998. This increase is almost twice as large as the increase in the nonresidential market. Over the next three years, construction costs of educational facilities should reach $63 billion. The greatest share of this money will go toward modernizing current facilities, followed by new construction (Baker, 1998).

To elevate schools to a good condition, an estimated $112 billion is necessary to complete repairs, renovations, and modernizations of educational facilities. Moreover

money is needed to build new facilities to accommodate growth. An estimated replacement cost for buildings described as both less than adequate and less than good would cost $148,491,616,000 (Honeyman, 1998). The cost of deferred maintenance has quadrupled in eight years from $25 billion in 1983 to $100 billion in 1991 (Hansen, 1992). An estimated 33% (or 25,000) of school buildings are in unsatisfactory condition. An estimated 14 million children attend schools that are in unsatisfactory condition (Honeyman, 1998).

In the last 20 years, our expectations for public education have increased markedly. Since this country's schools were put under the microscope in early 1980s, waves of school reform have passed with the intent on raising the standard for students, teachers, and administrators. Standards have been raised for students, teachers, and administrators; however, when school building design is considered, we continue to struggle and seem to be content on just getting by (Bradley, 1998).

Statement of the Problem

We must challenge the notion that educational facilities are only "containers" in which learning occurs. Also, we must challenge the notion that the design of these containers has little to add to the educational process. It is time for facilities to be viewed as tools that influence learning. However, few statistical studies have been conducted to analyze the effects of the school facility upon students' learning.

Purpose of the Study

This study was undertaken to determine if there were possible relationships between student achievement and the educational facilities. Within this context this study proposed to focus on the following question: Does school design influence the

academic achievement of elementary school students? The purpose of this study was to examine the relationship between building design and student achievement. Student achievement, the criterion variable, was restricted to the mean Iowa Test of Basic Skills (ITBS) composite reading and mathematics scores of third and fifth grade students per school site. Schools were selected randomly. A design assessment scale was used to determine the degree that a given design element was present in the school setting. This study examined 86 independent variables that were descriptors of design patterns. Design patterns include how the schoolhouse is made, how it is arranged, and how the outside areas near the school complement the curriculum. The primary academic work influencing the development of the design scale is credited to Alexander, Ishikawa, and Silverstein (1977). The 86 items were distributed into 11 generic subscales to simplify categorization and data analysis.

These subscales were based upon the classifications provided by Alexander, Ishikawa, and Silverstein, (1977); Taylor, Aldrich, and Vlastos, (1988); Lang, (1996); Anderson, (1999); and Ayers, (1999). Based on the writers cited here, the following subscales were developed:

1. Movement Patterns — The entry and exit dynamics should contain clues, which lead students into and from an environment with elements of anticipation or resolve. There should be spaces that foster a sense of community. Movement within and around the building should be comfortable and stress free.
2. Large Group Spaces — These areas can be for the entire class, private uses, or for small groups. They should be aesthetically pleasing and

comfortable, providing the proper space and furniture to complete learning tasks. Work zones may be set up in interdisciplinary centers or organized around a discipline, and the staff and students should feel safe.

3. Architectural Layout — This is the overall flow and functionality of the facility that considers the relationship of each area to other areas, i.e., is administration centralized within the building?
4. Daylighting and Views — The facility should be capable of bringing natural light into the learning environment. Windows may have some form of glare control, but should be in use (when glare is not a problem), and be without painted obstructions and other devices that restrict views. Windows should invite the outdoors inside.
5. Color — Visual stimulation and background detail should be present but not overwhelming. This detail should be subtle, not even noticed by adults, yet intriguing to children. Differing ceiling heights, patterns on walls or doors, with places or colorful displays are a few examples of items in this subscale.
6. Scale of Building — This includes the height of different aspects of the building, including windows, water fountains, door handles, etc. Scale is the relationship of people to objects.
7. Location of School Site — The school should be in harmony with nature and in context with its surrounding neighborhood. There should be a transition area between the playground and the classroom. This area

should be an extension of the classroom and used for art, projects, construction, gardening, etc.

8. Instructional Neighborhoods — Designed areas [wing(s) of the building] that include teacher-planning spaces, flex zones (places for multiple use), small and large group areas, wet areas for science and art, hearth areas, and restrooms. The hearth area is a place used for reading and quiet time.
9. Outdoor Environments — This consists of all areas outside of the school building that are located on the school's property.
10. Instructional Laboratories — These are better known as classrooms.
11. Environmental Conditions — This subscale pertains to the acoustics, climate control, lighting system, and roof of the facility. Properly working systems are invisible to the people inside of the facility.

An overall purpose of this study was to test each of the subscale design factors to determine their importance to student achievement.

Research Hypotheses

The research hypothesis was that there would be a positive correlation between third and fifth grade students' academic achievement and measures of the 11 design patterns described above. It was hypothesized that the 11 areas of the assessment instrument would be statistically reliable in order for the research hypothesis to be upheld.

Significance of this Study

Because of current educational practices and massive construction needs, a study of this nature was desirable and timely. The dearth of data concerning the effects that

school facilities have upon students illuminates the strong need for more research in this area. If a relationship was found between school design and student achievement, architects and school system personnel could use this knowledge before embarking on new construction projects in order to provide students with optimal learning environments. In particular, this study closely examined elementary school facilities in west central Georgia.

Assumptions

1. The Design Appraisal Scale Elementary (DASE) Version 2000 is valid and reliable (see Chapter 3).
2. The sample chosen was representative of elementary schools in the west central Georgia area.
3. The curriculum used throughout the sample was the Georgia state-mandated Quality Core Curriculum (QCC). The curriculum was the same across the sample population.
4. The percentage of students receiving free or reduced lunch was a valid measure of socioeconomic status (SES).
5. Teacher quality, as measured by level of education, was the same across the sample population.
6. The composite Iowa Test of Basic Skills (ITBS) scores for the third and fifth grade were reflective of the achievement level of the entire school.
7. The rater was consistent in assigning scores and did not know the school's mean ITBS score prior to the site visit.
8. The rater's scores were reliable.

9. Items within each of the eleven subscales were equally weighted.

Limitations of the Study

This study was limited by the following factors:

1. The schools in the sample population were located only in the west central Georgia area.
2. Only elementary schools that had been operating for at least the last five years were included in this study.
3. The Iowa Test of Basic Skills (ITBS) was the only measure of achievement used in this study.
4. While founded on related literature, the DASE instrument is subjective.
5. Each subscale was weighted equally on the DASE instrument.
6. Individual items in each subscale were weighted equally on the DASE instrument.
7. Only one rater scored schools using the DASE instrument.

Definition of Terms

The following definitions were used in this study.

1. Elementary school —This is a facility consisting of grades pre-kindergarten or kindergarten through fifth grade.
2. The Design Appraisal Scale Elementary (DASE) Version 2000 — This is an evaluation instrument used to measure the school design elements identified in this study. School design features are individual elements that can be added or deleted from the design of a school. Examples of features include windows, paint, doors, etc.

3. Socioeconomic status (SES) — This is measured by the percentage of students that participate in free and reduced lunch program in each school.
4. Acoustical environment — This refers to how sound travels through the building, based upon ambient noise level, reverberation time, and the signal/noise ratio.
5. Thermal environment — This refers to the climate controls in the school building.
6. Aesthetic environment — This is the color scheme and patterns of the building.
7. Visual environment — This is the amount of windows and the degree of lighting in the building.
8. Outdoor environment — This consists of all areas outside of the school building that are located on the school's property.
9. Scale of Building — This refers to the height and size of different aspects of the building, including windows, water fountains, door handles, etc.
10. Personal space — This is the amount of space needed by individual children to feel comfortable and safe.
11. Overall building condition — This refers to how well the building has been maintained.

Organization of the Study

Chapter I presented the introduction, statement of the problem, purpose of the study, research hypothesis, significance of the study, assumptions, limitations, definitions of terms used, and the procedures that were used to conduct the study. Chapter II

consists of a review of the literature about school facilities and how design features of a school affect the achievement of students. Chapter III describes the methodology of the study, a summary of the problem, the procedures and criteria used to select the sample population, a description of the sample population, the instrument used in the study, and a description of how the data were analyzed. Chapter IV reports the findings of the study based on the results of the testing of the hypothesis. Lastly, Chapter V summarizes the findings, presents the concluding interpretations along with implications, and lists recommendations to consider for future research.

CHAPTER II

LITERATURE REVIEW

The purpose of this study was to examine the relationship between school design and student achievement. There is a limited amount of data in this area of research. The related literature that is germane to this study is presented in this chapter in the following order: movement patterns, large group spaces, architectural layout, daylighting and views, color, scale of building, location of school site, instructional neighborhoods, outdoor environment, instructional laboratories, environmental, and overall building condition. This literature review specifically addresses the 11 subscales found in the DASE instrument.

Movement Patterns

According to Castaldi (1994) the architectural design of student circulation space has an obvious influence on the educational function of a school building. Circulation patterns must permit student traffic to flow quickly from one part of the building to another (Castaldi, 1994). Colven (1990) argued that movement within the school should not consist of a progression of individual experiences but instead be a conscious and perceptible environmental exchange. Accessibility and circulation are factors to consider when dealing with resources and specialized environments (Valiant, 1996).

According to Tanner (1999) special attention should be given to circulation patterns. Complex structures that cause crowding should be avoided. Movement within

a school is an important part of learning. School design should have pathways both inside and outside of the building. Indoor pathways could be color coded to aid in keeping students oriented to the front, back, and other important locations within the learning environments. Pathways may link structures together and into the natural environment. Pathways free of obtrusions between activity areas and classrooms improve utilization of learning areas.

Due to being considered comparatively unimportant, circulation areas have often been eliminated or integrated into teaching areas, frequently with disastrous consequences in terms of noise and disruption. The need for quick and effective movement within schools is important (Colven, 1990).

Large Group Spaces

There is a growing awareness of the importance of social areas in schools. This goes beyond the traditional requirements of rooms in which pupils and teachers can meet and eat, and stems from the view that an overall atmosphere needs to be created in which pupils can identify with, and feel ownership of, the environment in which they study and play. Social space should provide places for quiet contemplation and for formal and informal play. A variety of places are needed, both inside and outside the school, where children can meet together in groups, sometimes small and sometimes large. Such spaces need the characteristics which provide a welcoming environment and promote a feeling of belonging (Colven, 1990).

Needs for privacy vary from place to place and seem to reflect the community in which the school is located. In urban densely-populated areas, people like to find a place

to get away from others. In a rural area, people view school as a place to meet and gather and are less likely to want places for privacy (Crumpacker, 1995).

Cochran, Hale, and Hissam (1984) measured the personal space required by 96 undergraduate students under indoor (vacant room) and outdoor (empty soccer field) conditions. Twelve male and 12 female students were included in the experimenters. Each approached a male and a female acquaintance on the soccer field and in the vacant room. The person approached said stop when he felt uncomfortable with the proximity of the examiner. The results show that interpersonal closeness generates less discomfort in open spaces which indicates the need to include larger spaces and outdoor learning in school designs.

Architectural Layout

Taylor (1995) believes educational architecture is a "three-dimensional textbook." This means that the learning environment is a functional art form, a place of beauty, and a motivational center for learning. Her research states that the architecture of learning environments can kindle or subdue learning, aid creativity, or slow mental perception. Buildings are visual objects, and as such they can be stimulating both in terms of their intrinsic design and their use (Colven, 1990).

Fiske (1995) indicated that there needs to be a rethinking of all aspects of the structure of schooling, including the design of school buildings and other physical aspects of the learning environment. The organization of space has a profound effect on learning. Students feel better connected to a building which by design anticipates their needs and respects them as individuals (Hebert, 1998).

When children attend a school obviously designed with their needs in mind, they notice it and demonstrate a more natural disposition toward respectful behavior and a willingness to contribute to the classroom community (Hebert, 1998).

Fran Hunkins, in a speech at the University of Washington in May 1994, called for the development of spaces that engage, challenge, and arouse. Brain-compatible learning requires much more interaction with the environment than current facilities allow (Valiant, 1996).

An alternative to designing one large building would be to design a school using a campus plan. Garbarino (1980) stated that when large groups of students are housed in a single facility, students become anonymous. A campus plan design should cultivate close peer and teacher associations. Garbarino (1980) also indicated that large numbers of students in a single facility are harder to control than small groups. Plath (1965) found that, to a large extent, the campus plan design lowered student deviancy.

Daylighting and Views

In this study visual daylighting and views refers to the use of windows and lighting within the facility. Traditionally windows were included in buildings to allow in a source of light and to provide ventilation. Now buildings are built with artificial illumination and mechanical ventilation ("Review of the Psychological Reaction to Windows," 1978). The results from research concerning how windows and light affects students are varied.

Tinker (1939) found that as the illumination intensity changed, there was a change upon speed of perception and upon fatigue in reading. He discovered that when foot-candles dropped below 3.1, there was a drop in performance efficiency. However,

performance was equally efficient at 3.1, 10.3, 17.4 and 53.3 foot-candles. Although the experiment suggests that only three or four foot-candles are required to read ten-point type, Tinker recommends that a minimum of 10 to 15 foot-candles of intensity be available at desktop level when reading to allow for a margin of safety.

In a study by Luckiesh and Moss (1940), 5th and 6th grade students in well-lighted classroom had significant increases in scores on the New Stanford Achievement Test compared to students in a poorly lighted classroom.

Chorlton and Davidson (1959) studied how glare affects students. They tested glare conditions in several areas of the room under various levels of illumination. Observers were assigned tasks such as reading text written by a # 2 pencil on ruled paper and reading print on an assortment of stock papers. The tasks were executed under different types of illumination systems. The results indicated that a loss in contrast of printed and pencil handwriting tasks can occur under certain lighting conditions.

Mayron, Ott, Nations, and Mayron (1974) reported that the use of full-spectrum fluorescent lighting and radiation shielding decreased the hyperactive behavior of students in two first-grade classrooms as compared to the students in two control rooms with standard cool white fluorescent lighting. Research also suggests that the ability to concentrate on instructions is strongly influenced by factors such as lighting (Horton, 1972). Chan (1980), however, found no significant difference in ITBS scores between eighth graders in public school among schools with fluorescent and non-fluorescent lighting.

Cooper (1964) studied the effects upon the educational climate of attending an elementary school-fallout shelter. The Abo school in Artesia, New Mexico is built

completely underground except for the entrance. He concluded that the students at the Abo elementary school were no more anxious nor did they have any worse attendance than students at other schools with or without windows in Artesia.

Romney (1975) studied how a windowed and windowless environment affected rote learning tasks, concept learning tasks, and perceptual tasks of sixth grade students. No significant relationship was found to exist between the absence or presence of windows versus rote, concept, or perceptual tasks.

According to Kuller and Lindsten (1992), windowless classrooms should be avoided for permanent use. Grocoff (1995) reports that windows do not disrupt the learning process by creating a distraction. Instead windows provide a relief, requiring only "soft" attention. The type of "soft" attention linked with window gazing is less intense than the focused attention used to draw pictures or doodle. It is easier for pupils to refocus their attention when engaged in tasks requiring "soft" attention as opposed to those requiring more focused attention.

The Heschong-Mahone Group analyzed data collected in a survey of more than 21,000 elementary school students. Their findings indicate a 2.5 point higher score in math and 2.3 point higher score in reading for students who are in classrooms with day lighting as compared to those without extensive day lighting (O'Connor, 1999).

Research showed that elementary students in North Carolina who transferred to a school with daylight in classrooms performed 5% higher on achievement tests after one year and 14% higher after three years than their old classmates. Students who moved to a school without such daylight did not show similar improvements (Harrigan, 1999).

Color

In this study color refers to the use of color schemes and patterns in the building. The influence of interior coloring on academic achievement has been investigated by a number of researchers and has been shown to have an effect on achievement and behavior. Horton (1972) states that repetition of color is boring unless it is interrupted by variations and contrasts. Rice (1953) conducted a study in three schools in the Baltimore area that were similar in size, age, teacher-pupil ratio, and socio-economic status. One facility was not painted, another was painted in the traditional white ceiling and green wall scheme, while the third was painted according to a paint manufacturer's specifications and involved bright, warm, or cool colors. Report cards before the schools were painted were compared to report cards after the schools were painted. Kindergarten children in the unpainted school experienced a 3% improvement; students in the traditionally-painted school had a 7.3% improvement; and students in the experimentally-painted school had a 33.9% improvement. In grades three through six, the experimental school experienced a 10.5% improvement in language arts; a 12.6% improvement in social studies; an 8.5% improvement in arithmetic; and a 10.0% improvement in art/music. The findings of this study suggest that a carefully planned color scheme appears to influence the achievement of elementary school children. Ketchan (1964) found that the greatest improvement in social habits, health and safety habits, work habits, language arts, arithmetic, social studies, science, music, and art occurred in the schools painted with a certain combination of colors.

Ertal and his peers randomly selected 473 children and administered intelligence quotient (I.Q.) tests to them. The children took the tests in rooms that were

painted either light blue, yellow, yellow-green, or orange. The children thought these rooms were "beautiful". The average I.Q. of these children went up 12 points from previously administered I.Q. tests. Another group of students took the I.Q. test in white, black or brown rooms. They thought these rooms were "ugly". The students in the "ugly" rooms had an I.Q. drop of 14 points. Another experiment was conducted using students in conventional kindergarten rooms (control group) and kindergarten rooms that were color-coordinated "beautifully" (experimental group). The students in the control group started off with a slightly higher average I.Q. After 18 months the students in the experimental group were 25 I.Q. points ahead of the control group ("Blue is Beautiful," 1973).

In contrast to the previous study, Chan (1980) compared achievement scores of eighth grade students on the ITBS and found no significant difference between students who attended schools with interior pastel colors and those who did not.

Color experts agree that reds, oranges and pinks are warm and stimulating colors, while most blues and greens are considered cool and relaxing. Most grays are thought of as neutral. Tints are " receding" and make the room look larger, while deep tones are "approaching" and make the room look smaller. Different age children prefer different colors. Young children prefer red, blue, green, violet, orange, and yellow. Although young children prefer bright colors, too many high contrasts should be avoided because they can produce fatigue. Upper elementary classrooms should be painted with the cooler hues of blue and green. Secondary school students require less visual distraction and do well with the cooler hues such as pastel green or aqua. In an auditorium the center of attention is the stage. The stage area should be in contrast to the

surrounding sidewalls, which should be a relaxing color like beige, peach or pastel green. The gymnasium is a room that produces more body heat; therefore, it should be painted in a cool receding color with little color contrast. The cafeteria should be painted a color that will stimulate the appetite. Such colors include pearl, coral, rose, or pumpkin (Smith, 1980).

People and animals are stimulated by brightness and by warm color. An increase in muscular tension, respiration rate, heart action, blood pressure, and brain activity occur under these conditions. Dim light and cool colors have the opposite effect. They encourage withdrawal from external stimuli and decreases in muscular tension, respiration rate, heart action, and blood pressure ("Don't Be So Casual About Colors In Your Classroom," 1970).

Scale of Building

Ensuring there is not too great a difference between what children want to do and what they can do builds self-esteem. For children to feel competent in regard to their personal needs, the environment must be "child-scaled". Water fountains, sink, toilets, doorknobs, and light switches must be easily accessible and effortless for children to use (Moore, Lane, Hill, Cohen, & McGinty, 1979).

Location of School Site

When new schools are built, many items are taken into consideration. School systems consider the instructional needs of the students they serve, enrollment, and whether to replace an old building or simply remodel it (Graves, 1993). Other items considered when building a new school are zoning, tax base, community growth patterns,

socio-economic problems, ethnic and racial composition, and the transportation of students (Sleeman & Rockwell, 1981).

Within the past 20 years, school systems have considered the natural surroundings and the built environment that surrounds the school so that the school's architecture matches the surrounding environment (Witcher, 1991).

Noise pollution of the surrounding area is an important factor to consider. Bronzaft and McCarthy (1975) conducted a study on the effect of train noise and reading ability. Public School 98 is a five-story building in Manhattan, which is approximately 220 feet west of an elevated subway track. Between the hours of 9:00 a.m. and 3:00 p.m. each day, 80 trains pass the school. The average noise level of a sixth grade class measured 59 decibels. When a train passed, the average noise level rose to 89 decibels. Classes on the east side of the building were interrupted every four and a half minutes for an interval of 30 seconds by the noise of the passing trains. The study indicated that the students were hindered in their reading proficiency by elevated levels of noise. They found that students on the east side of the school building, which is only 220 feet from an elevated subway track, were academically behind their peers on the quieter west side of the building by as much as three months up to one year.

A school site should be safe, healthful, attractive, and properly located with respect to students' homes. Sites should be free of air pollution and noxious gases. Sites should be far from sources of noise or danger such as greatly traveled highways, airports, and heavy industry. Aesthetic considerations should be stressed in the selection of a site. Trees, brooks, parks, or golf courses near a school do much to beautify the area surrounding an educational facility. A good site should have several physical

characteristics. Its topography should be slightly convex and slightly higher than the area immediately surrounding it. Safety should be given high priority when selecting a school site. Sites should not border a heavily traveled highway, railroad, or high-tension electric wires. A landscape architect is an essential person needed in site planning. Landscaping is important to the development of the site. Trees, shrubs, flowerbeds, and the arrangement of walks and drives contribute to the general environment of a school building. Both the design of the building and the layout and development of the site are important ingredients in the creation of an atmosphere that is educationally stimulating. The building should blend pleasingly into the terrain, and the site should accentuate the beauty of the structure (Castaldi, 1994).

Instructional Neighborhoods

Although teachers and students feel the need for differentiated learning spaces, research to guide the customization of classrooms is scarce. The traditional "one size fits all" classroom is quickly becoming obsolete. Desks are being replaced with workstations and furniture suitable for cooperative learning. Space is needed to build, store, and display objects. The setting in which students are taught may be uncrowded and in good condition, but is it adequate for the functions that need to be undertaken? Adequacy of the learning environment depends not only on square footage, but also on how the square footage is configured and organized with relation to other areas (Duke, 1998).

Halsted (1992) predicted that the classrooms of tomorrow will be similar to studios. There will be workstations and research space for each student. There will also be an assortment of spaces of various sizes. Common in schools will be central gathering

places and presentation arenas. Workspaces for cooperative learning, quiet private areas, and nooks where students can think and work independently will be found in tomorrow's schools. Finally, teachers will have offices where they can do individual testing and counseling, organize individualized study programs, or telephone parents.

Rydeen (1993) is an architect who believes that schools should be designed to adapt to future needs. He noted that the schools should be flexible enough to support a variety of changing instructional strategies. Folding partitions, large group lecture rooms, small group spaces, and staff offices are a few of the designs that he deems necessary.

Because curriculum and instruction are continually changing to meet the needs of the students, so must the classroom space. Building flexibility into the classroom space is vital according to Lang (1996). He suggested that the physical environment should respond and adapt to the needs of both the teacher and the learner. Brubaker (1998) studied classroom space and found that even though there have been changes in technology, classroom space has in effect been left unchanged since the 1950's. Colven (1990) indicated that teachers should strive to make spaces for teaching and learning exciting and stimulating. Teachers should be prepared to develop and re-develop these spaces. This underscores the need to design buildings as flexible as possible.

Lomranz, Shapira, Choresh, and Gilat (1975) studied the amount of personal space children required. Measures of personal space were collected from 74 children aged three, five, and seven years. A significant difference at the .05 statistical level was discovered between the space needed by the three-year olds and that of the five-and seven-year old children. The three-year olds needed significantly less personal space

than the older children. The gender of the child was also meaningful. Both boys and girls needed less personal space when approaching girls rather than boys. The inclination to be closer to girls than to boys mainly occurred with the three and seven-year olds. Three-year old boys sat 15.16 cm away from girls, and three-year old girls sat 16.16 cm away from girls. Five-year old boys sat 23.33 cm away from girls, and five-year old girls sat 25.66 cm away from girls. Seven-year old boys sat 19.00 cm away from girls, and seven-year old girls sat 18.57 cm away from girls.

Adams and Zuckerman (1991) measured the personal space required by 28 female undergraduate college students under light and dark conditions. The subjects were escorted to the middle of a well-illuminated or dark room. The subjects were approached by another female and were told to say stop when they began to feel uncomfortable. Under the dim illumination condition, the average distance when discomfort began was 117.34 cm. Under the high illumination condition, the average distance when discomfort began was 53.2 cm. Interpersonal closeness was found to cause significantly less discomfort under high illumination than it did in darkness.

White (1975) found that personal space requirements increase as the size of the room decreases. Savinar (1975) measured the personal space needed under different ceiling heights. Thirty male and 30 female undergraduate students were the subjects for the experiment. The subjects were positioned in a room and instructed to say stop when an approaching person made them feel uncomfortable. They found that personal space requirements for males increase as the height of the ceiling decreases. When the ceiling height was lowered from nine feet to six feet, the desired personal space for males increased from 7.5 inches to 19.8 inches.

According to Proshansky and Wolfe (1974), privacy has been shown to contribute to a child's growth and development. Mack (1976) has conducted research on the "privacy booth," which is a classroom niche where a single student can work in seclusion. These privacy booths were often secluded and did not permit a view to the outside. Students like to withdraw but do not like total seclusion.

Curtis and Smith (1974) created places for children to hide away in, only to discover that children did not use them because they could not see what was happening around them. They solved this problem by adding clear acrylic panels to the private spaces. This allowed the children to see what was going on around them while maintaining their sense of physical privacy.

Outdoor Environment

Playgrounds have evolved a great deal over the past several decades. Those constructed in the 1950's and 1960's were made of metal and consisted of slides, swings, and monkey bars. Many older playgrounds, even those as new as the 1990's, are unlikely to meet current safety and accessibility guidelines. The playgrounds of today are not only safer, but they offer a greater sense of challenge and exploration through the installation of modular structures (Fanning Howey Associates, 1997).

Stine (1997) suggested nine dimensions to assess outside play environments. Both elements in each of the nine pairs are needed to meet the needs of children intellectually, socially, cognitively, and physically. The nine elements are:

1. Accessible and Inaccessible — An environment should provide cues about what is accessible and what is not. Due to their size, children view the world differently from adults. The ground area is very accessible.

Changing the ground surfaces impacts their play. Inaccessible areas should be seen as both positive and negative. These areas are positive when they provide clarity and safety, but are negative when children cannot reach a piece of equipment.

2. Active and Passive — This area should have spaces where children can be loud and participate in large muscle activities in conjunction with areas for children to relax and be calm.
3. Challenge/Risk and Repetition/Security — Children should learn about their competencies and limitations in this area. All children fall along a continuum of low to high physical abilities. This area should allow children to progress along the continuum without frustration.
4. Hard and Soft — This is an area where an environment gives way under the body's touch. It appears "soft". Children need to touch and feel mud, grass, sand, etc. However, for students to use toys with wheels, stack blocks, or colors, a hard surface is required. There should be both hard and soft areas to accommodate children's needs.
5. Natural and Built — To learn about, value, and ultimately protect their world, children need to understand and experience their world in both its natural and built forms. They need to understand the process to appreciate the product.
6. Open and Closed — Open-ended activities let a child become involved with the process of the activity without concern about an end product. There is no particular goal when the activity is finished. These activities

allow for discovery and exploration. Closed activities provide the child with feedback, indicating that a product is finished or that an activity is completed. The activities help develop self-esteem.

7. Permanence and Change — Children need landmarks to help them feel safe in knowing that they can negotiate the area and find their way back. Children also need to be a part of changing their environment. When an environment cannot be rearranged, the students lose out on an opportunity for creativity and problem solving.
8. Public and Private — The environment should have different spaces where children can gather and be with friends and spaces where a child can be alone. Children need to be able to make choices to be in a group or alone.
9. Simple and Complex — When an area has more than one type of material with more than one obvious use and allows for manipulation and change, it is called a complex area. Complex areas encourage children to make choices and decisions. Simple areas have items that have one obvious use only. These simple areas provide structure and direction for the child. (Stine, 1997)

Instructional Laboratories

In 1998 American schools invested $5.2 billion in technology, outpacing 1997's spending of $4.3 billion. Ten years ago there was one computer for every 37 students. Today there is a computer for every 7 students. 70% of American schools (80% of high schools) are connected to the Internet. Almost all of the money spent in technology goes

for hardware. However, only 15% ofteachers have appropriate technology training (Ravitch, 1998).

Teachers and policy makers alike see computers as a crucial element in educational reform. In a national teacher survey, 96% of teachers favored using computers and technology to improve the educational system in the United States (Feistritzer, 1996). Congress appropriated $698 million for educational technology programs in fiscal year 1999, including $75 million earmarked specifically for teacher training in technology (McAllister, 1998). Designing environments that facilitate these technical processes seems clearly needed (Latham, 1999).

Wenglinsky (1998) used data from the 1996 National Assessment of Educational Progress (NAEP) to determine the effects of computer use on math achievement for 4th and 8th grade students. He used teacher replies to a NAEP questionnaire to link classroom computer practices with the NAEP math scores of over 13,000 students. He found that, depending upon how the technology is used, technology positively impacts achievement. Achievement gains were higher for the 8th graders that used computers than it was for the 4th graders who used computers. Also, students who had teachers that had received staff development in how to use computers to teach higher-order thinking skills had larger gains than students of teachers who did not receive any training.

Environmental

A growing body of research confirms that many students cannot hear clearly and comfortably in class. Audiologists add that even students with no hearing impairments may have difficulty hearing what a teacher is saying in a modern classroom

due to poor acoustical design. Everyone is affected by poor acoustics, but the ones hindered most are those students who are hearing impaired, learning disabled, or have limited English proficiency (Day, 1999).

School buildings are filled with many different sounds from many different sources. Classroom acoustics are based on three factors: ambient noise level; reverberation time (RT); and, the signal/noise ratio (S/N). Ambient noise is background noise. Examples include the hum of the heating system, cars passing by, and other students whispering. Reverberation time (RT) is defined as the interval needed for a sound introduced into an environment to reduce its intensity once the sound is turned off. "Signals" are the desirable sounds and "noise" is the undesirable sound. The association between signals and noise is the S/N ratio (Day, 1999).

Schools frequently have hard floors, concrete walls, high ceilings, windows, and chalkboards, all of which cause a long reverberation time (Scott, 1999). Other factors at schools that cause noise are playgrounds, corridors, ventilation systems, scraping of chairs, doors slamming, peoples' voices, and passing traffic (Day, 1999).

Signals are what people desire to hear; noise interferes with this desire. The signal should be stronger in intensity than the interfering noise. In a classroom with an above average acoustic design, students with no hearing impairments understood 71% of what the teacher said. However, students with hearing-impairments only understood 48% of what was said by the teacher (Day, 1999).

Scientists at Heriot-Watt University in Edinburgh, Scotland, stated that the percentage of voice consonants lost in the echoes was between 15 and 50% (Scott, 1999). Kyzar (1977) conducted sound level testing in 21 different schools over a 19- year

period. He concluded that 65 decibels is an acceptable level of background noise, but background noise levels were unacceptable at 75 decibels. Cohen and Lezak (1977) concluded that human energy and efficiency decline due to unwanted noise.

Woodhead (1964) conducted tests concerning noise with 84 young Royal Naval enlisted men with normal hearing. The subjects were allotted 10 seconds to remember a six digit number. A four-digit number then appeared on the screen, which they had to subtract from the original six-digit number. Some of the subjects heard bursts of noise during the memorization of the six-digit number and some did not. Some of the subjects heard bursts of noise during the calculations and some did not. Research results showed that when noise occurred during the calculating period, the rate of work increased throughout the session. When the bursts of noise occurred during memorization of the six-digit number, there tended to be more errors made in the calculations.

Thermal environment or climate control is another environmental factor that has been the topic of several studies. The comfort index strongly influences the physiological state of the student and the teacher. A comfortable temperature of 72 degrees Fahrenheit requires a relative humidity of 60%. As the temperature of the air rises, the humidity should decrease to maintain comfort level (Castaldi, 1994).

Herrington (1952) found that workers who performed minimal physical exertion produced the least errors at 79 degrees Fahrenheit. As temperatures rose to 97 degrees Fahrenheit, errors increased from 12 per hour to 90 per hour. He also noted that women who control thermostats would set it an average of 3 to 4 degrees higher than men. Also, younger children prefer a temperature of about 5 degrees cooler than an older adult.

In a survey conducted by McDonald (1960), teachers were asked in a questionnaire what affect air conditioning has on teacher attitudes, work patterns, and classroom conditions. The conclusions were that air conditioning appears to improve both the teachers' attitude and work pattern. This is mainly due to less fatigue and greater flexibility. Air conditioning also seems to improve student performance mostly by providing a climate in which it is easier to concentrate. Air conditioning tends to improve the students attitude and behavior patterns mainly due to less drowsiness and fatigue. Of the teachers surveyed, 28% reported improved grades; 38% reported willingness to do more work; and, 85% reported that their students showed a greater ability to concentrate when functioning within an air-conditioned environment.

Nolan (1960) also stated that higher temperatures have a negative impact on academic learning. Peccolo (1962) conducted a study using 44 matched pairs of fourth grade pupils. His study indicated that an appropriate thermal environment had a positive relationship to the learning of new concepts and to the performance of clerical tasks where quick recognition and response were required. McCardle (1966) conducted a follow-up study involving 40 matched pairs of sixth graders. His study showed that pupils in a thermally-controlled room committed significantly fewer errors on conceptual learning tasks and needed less time to complete assigned tasks than those in the room with no thermal controls. Stuart and Curtis (1964) showed that the gain of student achievement in climate-controlled facilities was superior to those in non-climate-controlled schools. Their study involved 5,000 pupils in three different grade levels at four different schools and spanned two academic years.

Chan (1980) found that students in schools that are air-conditioned score significantly higher at the .05 level on the vocabulary section of the ITBS than students who are in non air-conditioned buildings. The achievement of students in an air conditioned versus non air-conditioned buildings was also analyzed for other sections of the ITBS. No significant differences were found for these sections. However, statistics showed a consistent pattern of higher achievement for students in the air-conditioned schools.

Overall Building Condition

Although overall building condition is not a subscale on the DASE instrument, a summary of the research on overall building condition is included in this paper because the general upkeep of the building can affect each of the DASE subscales. Since the 1960's there have been studies reporting the relationship between a school building's condition and student achievement and behavior. Thomas (1962) studied the relationship of student achievement and school building age in 206 secondary schools. Results showed a significant relationship between school building age and student achievement. The students that attended older schools in established neighborhoods outperformed students that attended newer schools in less established neighborhoods.

Burkhead, Fox, and Holland (1967) studied a sample of 138 secondary school buildings in large cities. Their studies indicated a significant relationship between reading scores and building age. Buildings in a newer category correlated with higher reading scores.

Gingold (1971) studied 230 students from elementary and junior high schools in Wisconsin. These students were housed in both new and old facilities. The students in

the new facilities had a more positive attitude as measured on a series of instruments than the students housed in an old facility. Guthrie, Kleindorfer, Levin, and Stout (1971) studied a sample of over 50 students. They found a significant positive relationship between school building age and reading ability, mathematical analyses, and verbal ability.

McGuffey and Brown (1978) studied school buildings in 188 school systems in Georgia. Results showed significant variance in student achievement that was attributable to school building age above and beyond the influence of the students' socioeconomic background. Students in older buildings tended to achieve less than students in newer buildings. The influence a school building's age has upon achievement differs among the grades. The strongest relationships were found at the fourth and eleventh grade levels. At the eighth grade level, only mathematics had a significant relationship to the age of the building.

Lezotte and Passalacqua (1978) analyzed data from 20 urban schools. Their research showed that schools (individual buildings) account for a significant amount of the variance in measured pupil performance. Plumley (1978) studied the relationship of school building age and student achievement of fourth grade students in selected schools in Georgia. The findings of the study revealed that 5% of the variance in student achievement was attributable to the age of the school building. Students being taught in older buildings, which did not have elements of modernization, had lower composite vocabulary, reading, language, work-study, and mathematics scores on the ITBS. However, Chan (1979) studied 189 Georgia middle school buildings and found only 1% of the variance in student achievement was attributable to the age of a school building.

Bowers and Burkett (1987) studied achievement scores, behavior records, attendance records, and health problems of 284 fourth and sixth grade students in the oldest and newest rural Tennessee elementary schools. Students in the modern building scored significantly higher than students in the older building in reading, listening, language, and arithmetic. Also significant is the fact that students in the modern building were disciplined less frequently than those in the older building. The students in the newer facility experienced significantly fewer major health problems and had significantly higher attendance than those in the older building.

Edwards (1992) concluded that the condition of the school was related to student achievement. The students in schools that were rated as poor had standardized test results that were 5.45% points below those students in schools rated fair. The difference between the excellently rated schools and the poor schools was 10.9% points.

Cash (1993) examined rural high schools in Virginia. She compared the condition of school buildings to students' scores on the Test of Academic Proficiency and their behavior. Each high school was evaluated on 29 items relating to the building's condition. She found that students in the above-standard buildings scored 5% points higher than the students in the school buildings rated as poor. Cash (1993) also analyzed the relationship between a student's behavior and school building conditions. She found that the students in facilities rated as poor had less reported incidents of misbehavior than students in the above-standard buildings. The building's cosmetic condition appeared to impact student achievement and student behavior more than the building's structural condition.

Earthman, Cash, and Berkum (1995) studied a sample of 120 high schools in North Dakota. The results of this study support other studies dealing with student achievement and behavior and the condition of school buildings.

Chan (1996) studied 165 schools in Georgia. Each school was classified as a modern learning environment, obsolete learning environment, or half modern learning environment. Results of this study indicated that students achieved the highest in the modern learning environment and lowest in the obsolete learning environment. The half modern environment was in the middle between modern and obsolete.

Maxwell, in cooperation with Council of Educational Facility Planners International (CEFPI), studied the effects of school renovation on Syracuse City School students. Beginning in 1984, several schools underwent renovations. Third and sixth grade student scores on the Pupil Evaluation Program (PEP) before, during, and after renovation were analyzed. Her findings showed a correlation between newer facilities and higher student performance. A significant relationship between higher math scores and an improved facility was found. However, reading scores were not significantly correlated to facility condition (Moore, 1998).

One conclusion that may be made from these studies is that students perform better academically in newer schools. Since all students can't attend new schools, there must be another factor. That factor may be custodial care and maintenance. Deferred maintenance is a problem in schools across America (National Center for Educational Statistics, 1999). This factor makes schools look older thereby influencing a negative view of the school environment.

Summary

To aid the reader, the table below describes how the literature review relates to the DASE subscales.

Table 1: Literature Review of the Subscales.

SUBSCALE 1 Movement Patterns	Castaldi (1994) Colven (1990) Tanner (1999) Valiant (1996)
SUBSCALE 2 Large Group Spaces	Cochran, Hale, & Hissam (1984) Colven (1990) Crumpacker (1995)
SUBSCALE 3 Architectural Lay Out	Colven (1990) Fiske (1995) Garbarino (1980) Hebert (1998) Plath (1965) Taylor (1995) Valiant (1996)
SUBSCALE 4 Daylighting and Views	Chan (1980) Chorlton & Davidson (1959) Cooper (1964) Grocoff (1995) Harrigan (1999) Horton (1972) Kuller & Lindsten (1992) Luckish & Moss (1940) Mayron, Ott, & Nations (1974) O'Connor (1999) Romney (1975) Review of Psychological Reaction to Windows (1978) Tinker (1939)
SUBSCALE 5 Color	Blue is Beautiful (1973) Chan (1980) Don't Be So Casual About Colors In Your Classroom (1970) Horton (1972) Ketchan (1964) Rice (1953) Smith (1980)
SUBSCALE 6 Scale of Building	Moore, et al. (1979)

Table 1 Continued: Literature Review of the Subscales.

SUBSCALE 7 Location of School Site	Bronzaft & McCarthy (1975) Castaldi (1994) Graves (1993) Sleeman & Rockwell (1981) Witcher (1991)
SUBSCALE 8 Instructional Neighborhoods	Adams & Zuckerman (1991) Brubaker (1998) Colven (1990) Curtis & Smith (1974) Duke (1998) Halsted (1992) Lang (1996) Lomranz, et al. (1975) Mack (1976) Proshansky & Wolfe (1974) Rydeen (1993) Savinar (1975) White (1975)
SUBSCALE 9 Outdoor Environment	Fanning Howery Associates (1997) Stine (1997)
SUBSCALE 10 Instructional Laboratories	Feistritzer (1996) Latham (1999) McAllister (1998) Ravitch (1998) Weglinsky (1998)
SUBSCALE 11 Environmental	Castaldi (1994) Chan (1980) Cohen & Lezak (1977) Day (1999) Herrington (1952) Kyzar (1977) Nolan (1960) McCardle (1966) McDonald (1960) Peccolo (1962) Scott (1999) Stuart & Curtis (1964) Woodhead (1964)

CHAPTER III

METHODOLOGY

The west central Georgia region was chosen for this study. The west Georgia Regional Educational Service Area (RESA) office was contacted to obtain the names of the school districts that are in that jurisdiction. A random sample of 25 elementary schools was selected from this area for the study.

All of the schools on the list were contacted, and site visit and tour of each facility was arranged. The order in which the schools were toured was arranged by geographic area and school schedules. A tour of each facility was conducted, and subsequently the Design Assessment Scale Elementary School (DASE) Version 2000 was completed by the researcher for each school. The DASE contains 86 items. Each of the 86 items was measured using a 10 point Likert Scale, where 10 is the highest score and 0 is the lowest score per item. Each school received an item score and a subscale score. The instrument was completed within one hour of the building tour and before visiting another school so that important information was not forgotten or confused with another facility.

After each of the schools had been toured and a DASE had been completed for each facility, the ITBS scores and other relevant information was collected from the Georgia Public Education Report Card for Parents for each school. This information included race, percentage of the students identified as gifted, students receiving free lunch, students paying a reduced cost for lunch, levels of certification among

professionals, and average years of experience for teachers. The above information was analyzed to determine if there was a correlation between student achievement and school facilities.

The Instrument — Design Assessment Scale Elementary (DASE) Version 2000

A brief description of each of the items in the DASE instrument is listed below.

Subscale 1 — Movement Patterns

The school's design will be judged regarding its ability to enable students to enter and move freely within and around a facility.

1. The promenade is the outside walkways that link the main areas. Ideally, the major activity centers are placed at the extreme ends of the facility.
2. Pathways are clear and comfortable avenues that allow freedom of movement and orientation among structures. These play a vital role in the way people interact with buildings. This pattern defines the overall philosophy of the layout.

Circulation Patterns are indoor spaces that allow for movement. The passages should be broad and well-lit, thus allowing for freedom of movement. Items three through seven list the various classifications of circulation patterns found within school facilities.

3. Circulation patterns within learning environments are adequate.
4. Circulation patterns within hallways allow students personal space when moving within the school.
5. Circulation patterns are easily supervisable.
6. Sufficient egresses from the building are necessary. The best situations are where students may exit directly from their classrooms.

7. Classroom exterior door(s) lead to a courtyard.

Items 8 through 17 apply to spaces for physically challenged students.

8. Classrooms are easily accessible for physically challenged students.
9. Hallways allow for easy access by the physically challenged students.
10. Access to, from, and within the lunchroom is effortless for the physically challenged students.
11. Physically challenged students can access the gymnasium without difficulty.
12. Access to the school building(s) is uncomplicated for the physically challenged student.
13. Toilets are accessible to the physically challenged students.
14. Drinking fountains are accessible to the physically challenged students.
15. Physically challenged student are able to use computer stations.
16. Access to the school grounds is handicap friendly.
17. The living center (teaching center) is easily accessible to all.

Subscale 2 — Large Group Meeting Spaces

The school's design will be judged regarding the ability for students to congregate in areas without being crowded.

Public areas are spaces that foster a sense of community (unity and belonging). The areas are inviting and comfortable settings that include ample lighting. Items 18 through 22 refer to large group meeting spaces.

18. Auditorium
19. Amphitheater
20. Media center

21. Commons (Spaces for casual student meeting)

22. Dining room

Archives are spaces for students to browse historical works of all cultures. The quality of the archive area refers to the amount of space made available and how it blends with the setting. Accessibility by all students is also an aspect of this quality.

23. The media center contains artifacts.

24. The media center contains documents.

25. The media center contains adequate amounts of literature.

Subscale 3 — Architectural Layout

The school design will be judged regarding the physical arrangement of the structure.

26. The entrance area should be a friendly space connecting the outside world to the inside world. This age appropriate space should be inviting and highly visible for students and visitors. It should evoke a "welcome" feeling.

27. The administration area is centralized. The main administrative offices are grouped together in a centralized area allowing for connection and convenience (assistant principals may be located elsewhere in the school). If there are schools within a school or a campus plan, the person in charge should be readily accessible, at least for the safety of the children.

28. The main building has an obvious point of reference among the school's buildings in which paths and buildings connect. This design feature heightens the sense of community. An example might be a clock tower at the front entrance.

29. Paths with goals are places designed to provide focal points when walking to particular locations. (e.g. displays of students, work, meaningful posters, benches, or plants).
30. Intimacy gradients provide a sequence from larger to smaller (public to private) spaces. This gives the effect of drawing people into the area. This is usually found in main entrances, but may be used throughout the learning environment.
31. The hallways are adequate for displaying student work
32. The teachers' workrooms are located with respect to classrooms.

Territoriality of place is defined as how comfortable the school is for the student regarding personal and social distance. Items 33 and 34 deal with territoriality of place.

33. The general social distance per student is calculated for the complete facility based on crowded conditions.
34. A variation of ceiling heights allows for individual comfort and intimacy within the school.

Subscale 4 — Daylighting and Views

The school is judged on its ability to bring natural light into the learning environment. Windows may have some form of glare control, but should be in use (when glare is not a problem), and be without painted obstructions and other devices that restrict views. Windows should invite the outdoors inside.

35. The window view should overlook plant or animal life.
36. Windows should allow unrestricted views (when glare/curtains is/are not a problem) of the outside world.

37. The school facility should provide adequate natural light. This includes skylights and "borrowed" light.

38. The building should have views of indoor and outdoor spaces (gardens, animals, fountains, mountains, people, etc.). These allow minds and eyes to take a break.

39. Each instructional area should contain both artificial and natural light from the outside, preferably on two sides of every room.

Subscale 5 — Color

The school will be judged on the impact of the color schemes chosen. Items 40 through 45 deal with color schemes.

40. Color schemes of the classrooms are appropriate, favoring lighter hues with stronger contrasting front walls.

41. Color schemes of the hallways are appropriate, favoring light hues with bright ends.

42. The lunchroom has a color scheme to induce appetite.

43. The gymnasium has an appropriate color scheme — light tones with bright color accents.

44. Background details consist of spaces of colorful displays on walls and doors (e.g. light switches, wall outlets, louvers, and surface raceways) that might be unnoticed by adults.

45. Walls and finishes effectively display color and vivid patterns to enhance visual stimulation.

Subscale 6 — Building Scale

The school is judged on whether it is built to the scale of children (e.g. door handles and handrails are low enough for children to reach easily). Items 46 through 52 all should scaled appropriate for the elementary child.

46. Light switches are the appropriate height.
47. Door handles are the appropriate height.
48. Handrails are the appropriate height.
49. Shortened steps are required for smaller children.
50. Water fountains are low enough for the students to comfortably reach without assistance.
51. Doors and windows should allow the student to easily see the outside world.
52. Developmentally appropriate playground equipment is available.

Subscale 7 — Location of the School

The school will be judged on the location of the school site and ability to blend with its surroundings. Items 53 through 55 apply to the school's location.

53. The site and learning environments are free of excessive non-pedestrian traffic and noise. Natural or built barriers may protect these areas to provide a safe site.
54. The school and grounds are compatible and in context with the surroundings and sufficient to facilitate the curriculum and programs.
55. The school is "in harmony with nature." It blends with the surroundings and brings nature into the learning environments.

Subscale 8 — Instructional Neighborhoods

The school design will be judged on whether it contains areas [wing(s) of the building] that include teacher-planning spaces, flex zones (places for multiple use), small and large group areas, wet areas for science and art, hearth areas, and restrooms. The hearth area is a place used for reading and quiet time. Items 56 through 71 apply to instructional neighborhoods.

56. Teacher planning areas are located within the instructional neighborhoods.
57. Flex zones are present within instructional neighborhoods.
58. Small group areas are available to students within instructional neighborhoods.
59. Instructional neighborhoods contain large group areas for instruction.
60. Wet areas for science are present in the instructional neighborhood.
61. Wet areas for art are present in the instructional neighborhood.
62. Instructional neighborhoods contain hearth areas.
63. Spaces that are designed for small group work (activity pockets) are present in instructional neighborhoods.
64. Instructional neighborhoods contain toilets within them.
65. Secured spaces for teachers and students to store their personal belongings, tools and supplies are provided within the instructional neighborhood.
66. Classroom walls are adequate for displaying students' work within the instructional neighborhood.
67. Quiet and solitary places that students may go to be alone within the instructional neighborhood are provided.

68. Private social supervisable spaces for small groups of children to work in (reading areas, quiet places, reflection areas, listening areas, etc.) are within the instructional neighborhood.
69. Classrooms create an atmosphere of excitement for learning.
70. Computers are placed within the learning environment in a manner that complements teaching and learning. Computers appear as an integral part of the curriculum.
71. General personal distance per student is adequate in the classrooms and work areas.

Subscale 9- Outdoor Learning Environment

The school grounds will be judged as to whether they provide enough suitable space for outdoor learning to be promoted.

72. Quiet areas or solitary places exist outside where students may go to pause and refresh themselves in a supervisable setting.
73. Social, supervisable places exist outside where a small group of children may go to be alone (i.e. reading areas, quiet places, reflection areas, etc.).
74. Defined spaces outdoors are similar to a classroom, but with the added beauties of nature.
75. Places exist on the campus that are defined by wings of buildings, trees, hedges, fences, fields, arcades or walkways.
76. Outside green spaces are close to the school building where trees, grass or gardens may be seen but not cars or roads.

77. Places in a school or on the school grounds for animals to live (e.g. butterfly houses, bird houses, trees, etc. are found). Caring for animals helps teach the students a sense of responsibility and respect.

Subscale 10 — Instructional Laboratories

The school will be judged regarding its use of space for laboratory classes.

Technology for students consists of spaces with computers, compact disks, programs, learning packages, Internet connections, television, and video.

78. Computer laboratories are not arranged in a rigid, institutionalized manner.

79. The designated space for music instruction is adequate.

80. The designated space for music performance is adequate.

Art — Quality of designated spaces for art.

81. The designated space for art instruction is adequate.

82. There is an adequate space designated to display an international photo gallery.

83. There is an adequate space designated to display students' artwork.

Subscale 11— Environmental Conditions

The school will be judged on its ability to be safe and comfortable.

84. Control of internal and external noises levels is adequate.

85. A system to maintain a comfortable temperature in the learning environment is adequate.

86. The school has a roof system in good repair.

Data Collection

A site visit was made to each school in order to complete a guided tour of the educational facilities and outdoor learning environments. A member of the school staff

was asked to lead this tour. The tour of the site was necessary to accurately complete the DASE for each facility. Only one researcher conducted each site visit. That same researcher completed an instrument for each facility within one hour of visiting the school and before visiting another school. All the site visits were completed before the data from the Georgia Public Education Report Card for Parents was obtained for data analysis. This was done to minimize bias in filling out the instrument for each school.

Following the site visits, the ITBS scores and other relevant information were collected from the Georgia Public Education Report Card for Parents for each school. Information regarding the ethnicity of the students in the school, education of teachers, and percentage of students receiving free lunch (and indicator of SES) was collected and coded for analysis. This was done last to minimize bias of the rater. That is, the rater did not know the status of the school regarding performance on the ITBS at the time of the site visit.

Validity and Reliability

The content validity of the Design Appraisal Scale Elementary (2000 Version) was established as a result of the review of literature. This was an extension of the instrument used by Andersen(1999) and Ayers (1999) in their studies of school design. Table 1 (Chapter II) shows each subscale on the DASE, and the literature reference to support its inclusion in the instrument.

Prior to use in this study, the DASE was pilot tested by a group of advanced graduate students studying school design and planning. The graduate students visited an elementary school and utilized the DASE instrument to appraise the school design. One week later, the same graduate students reevaluated the identical school with the DASE

instrument. The results of the pilot test were analyzed using a test-retest method of analysis in order to determine reliability. The test-retest reliability of the instrument was found to be .82 (Tanner, 2000).

Data Analysis

A spread sheet listing each school and it's scores on the DASE was compiled (See Appendix A). Added to this list was the information gathered from the Georgia School Report card concerning demographics, experience, certification, and composite ITBS scores for the 3rd and 5th grades. A regression analysis was completed using this data. This included controls for social and economic variables' influence on ITBS scores by utilizing the backward elimination process. This process determines the best prediction equation. Multiple regressions (both full and reduced models) were calculated and then percentage of change in the variance for each design element was determined.

Research Design

The sample for this study was randomly selected. This study was a non-experimental design. Multiple regression (full and reduced) was used to determine the relationship between 3rd and 5th grade student achievement on the ITBS and the school's score on the DASE instrument.

CHAPTER IV

FINDINGS

Initially 25 schools were randomly chosen to participate in this study. All of the schools agreed to participate. However upon arriving at one school, it was determined that this school did not fit into the category of an elementary school. This school had one class of sixth grade students and one class of seventh grade students that were exempted from attending the middle school in the area. Therefore data were collected on 24 schools or 96% of the original number contacted.

Reliability of the Subscales

Following the data collection procedures as described in Chapter III, an analysis was conducted on the data collected for the 86 items on the DASE instrument. The first problem was to refine the subscales according to the data distributions before making comparisons of the results with the student achievement data. An item to scale analysis (Cronbach's alpha) was conducted to determine the relationship between an individual item and the rest of each subscale. A Chronbach's alpha is the number of items times the average covariance between items divided by the average variance. This product is divided by one plus the number of items minus one times the average covariance divided by the average variance of all the items (Norusis, 1990).

This statistic is interpreted as a reliability coefficient or index of stability. There are various acceptable levels of reliability according to Garrett and Woodworth (1958). At this point in the data analysis, it became important to know if the reliability coefficient

was satisfactory. According to these authors, the size of the reliability coefficient that is needed depends upon the nature of the instrument and the purpose for which it was designed. Garrett and Woodworth state that a reliability coefficient need be no higher than 0.50 or 0.60 if the instrument is designed to make a diagnosis (separating or classifying people, for example). Since this study focused on identifying design patterns as possible factors in student achievement, a reliability of .50 was set as a criterion for each subscale. For this data set, eliminating items that might keep the reliability coefficient below .50 maximized the Cronbach's alpha. If through the process of eliminating design items the .50 could not be obtained for a subscale, this particular subset was eliminated from the study to maintain acceptable reliability. The items were assumed to be valid since they were derived from the literature and research on school design and planning as discussed in Chapters II and III. Table 2 reveals the reliability coefficients for each subscale. Two subscales did not meet the criteria of .50 and were eliminated from this study. This does not necessarily mean that these items are not valid. As far as this data set is concerned, they were not reliable and therefore could not be used in the analysis.

Table 2: Reliability Analysis for the Subscales

Category	Chronback's Alpha	Spearman-Brown Equal Length	Spearman-Brown Unequal Length
Movement Patterns (n = 17)	.63	.76	.76
Large Group Meeting Places (n= 3)	.70	.63	.65
Architectural Design (n=6)	.70	.65	.65

Table 2 Continued: Reliability Analysis for the Subscales

Daylighting and Views (n=5)	.82	.87	.87
Color Schemes (n= 6)	.79	.81	.81
Scale* (n=7)	.49	.50	.50
Location (n=3)	.74	.68	.69
Instructional Neighborhoods (n=16)	.54	.79	.79
Outside Learning Areas (n=6)	.87	.86	.86
Instructional Laboratories (n=6)	.74	.74	.75
Environmental* (n=3)	.19	.20	.17

* These subscales were eliminated from the study because their reliability coefficients were less than .50.

Determining Categories for Analysis

Next, the scores for each subscale were computed for each of the 24 schools. This process included computing a new variable for each category. For example, items 1 to 17 made up the subscale entitled "Movement Patterns." Based on the assumptions that the scale is additive, this procedure results in a score that may be interpreted as follows: the higher the score, the better the learning environment.

Control Variables

There were several variables that might possibly influence the ITBS scores in the 24 schools. Most prominently these included race, percentage of the students identified as gifted, students receiving free lunch, students paying a reduced cost for lunch, levels of

certification among professionals, and average years of experience for teachers. These variables were used as covariates throughout the analysis.

Comparison of ITBS Scores and Design Patterns

On Third Grade Composite Scores

The first step was to determine which of the possible control variables (free lunch, gifted, Hispanic, percent black, certificate level [T4 ,T5, T6, T7], average experience, percent white, and percent other) would be the best predictors of the third grade composite ITBS scores for the 24 schools. Backward elimination was used to determine when any variable would not add significantly to the prediction equation. The goal was to select the equation with the highest adjusted R Square. In Appendix B Table 6 and 7 reveal an adjusted R square of .599 ($F = 9.60$; $p = .0002$), indicating that the R Square of .669 was significantly different from "0". This equation included free lunch, average experience, percent white, and percent other (student population). Tables 6, 7, and 8 in Appendix B illustrate the results of the backward elimination process used to determine the best variables for the prediction equation.

Next the design variables were added one at a time to determine how much each addition would change the R Square (see Table 3). Appendix C contains the results of the statistical tests that were used to determine the change in the R Square. Appendix C consists of tables 9 through 35.

Initially reduced regression models containing the correlative variables of percentage of students receiving free lunch, number of years of experience the teachers had, percentage of white students, and percentage of other students were calculated. Then in a stepwise fashion, full regression models were calculated which included the

criterion variable as well as the correlative variables in the reduced model. The difference in the R squares between the reduced regression model and the full model containing the criterion variable is the change in the R Square that is attributed solely to the criterion variable of school design.

For the first criterion variable of movement, the reduced regression model calculated an R square value of .669. The full regression model calculated an R square value of .704. The difference between the reduced and full regression model is .035. Therefore, movement accounts for 3.5% of the variance. These results are found in Appendix C in tables 9, 10, and 11.

The second criteria variable was large group meeting places. For this second criterion variable the reduced regression model calculated an R square value of .669. The full regression model calculated an R square value of .704. The difference between the reduced and full regression model is .035. Therefore, movement and large group meeting places accounts for 3.5% of the variance. Thus large group meeting places accounts for 0.0% of the variance. These results are found in Appendix C in tables 12, 13, and 14.

For the third criterion variable of architectural design, the full regression model calculated an R square value of .730. The difference between the reduced and full regression model was .061. Therefore, architectural design, large group meeting places, and movement account for 6.1% of the variance. Thus, architectural design accounts for 2.6% of the variance. These calculations are found in Appendix C in tables 15, 16, and 17.

The fourth criterion variable set was daylighting and views. Since the reduced regression model produced an R square value of .669 and the full regression model

calculated an R square value of .731, the difference between the reduced and full regression model was .062. Therefore daylighting and views, architectural design, large group meeting places, and movement accounts for 6.2% of the variance. Thus, daylighting and views alone accounted for .1% of the variance. These results are found in Appendix C in tables 18, 19, and 20.

Color scheme, the fifth criterion variable set, had a calculated R square value of .735. The difference between the reduced and full regression model was .066. Therefore color scheme, daylighting and views, architectural design, large group meeting places, and movement accounted for 6.6% of the variance. Color scheme alone accounted for .4% of the variance. These results are found in Appendix C in tables 21, 22, and 23.

Next, for the sixth criterion variable of location , the calculated an R square value was calculated to be .768. The difference between the reduced and full regression model was .099. Therefore location, daylighting and views, color scheme, architectural design, large group meeting places, and movement accounts for 9.9% of the variance. Location accounted for 3.3% of the variance. These results are found in Appendix C in tables 24, 25, and 26.

For the seventh criterion variable of instructional neighborhoods, the full regression model calculated an R square value of .776. The difference between the reduced and full regression model was .107. Therefore instructional neighborhoods, location, daylighting and views, color scheme, architectural design, large group meeting places, and movement accounts for 10.7% of the variance. Thus, instructional neighborhoods accounted for .8% of the variance. These results are found in Appendix C in tables 27, 28, and 29.

The eighth criterion variable was outside learning areas. For this criterion variable, the reduced regression model calculated an R square value of .669. The full regression model calculated an R square value of .808. The difference between the reduced and full regression model was .139. Therefore outside learning areas, instructional neighborhoods, location, daylighting and views, color scheme, architectural design, large group meeting places, and movement accounts for 13.9% of the variance, with outside learning areas accounting for 3.2% of the variance. These results are found in Appendix C in tables 30, 31, and 32.

Lastly, when the ninth criterion variable was added, instructional laboratories, the full regression had an R square value of .811. The difference between the reduced and full regression model was .142. Therefore instructional laboratories, outside learning areas, instructional neighborhoods, location, daylighting and views, color scheme, architectural design, large group meeting places, and movement accounts for 14.2% of the variance. Thus, instructional laboratories alone accounted for .3% of the variance. These results are found in Appendix C in tables 33, 34, and 35.

Table 3 summarizes the change in R square as each design subscale was added, one at a time, to the analysis.

Table 3: Regression Analysis of Third Grade Composite ITBS Scores

Criterion Variable	Regression Model	Correlative Variable	R Square	Change in R Square Attributed to School Design Variable
Movement	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.035
	Full	Reduced and Movement	.704 (p=.0003)	
Large Group Meeting Places	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.035
	Full	Reduced, Movement, and Large Group Meeting Places	.704 (p= .0009)	
Architectural Design	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.061
	Full	Reduced, Movement, Large Group Meeting Places, and Architectural Design	.730 (p= .0013)	

Table 3 Continued: Regression Analysis of Third Grade Composite ITBS Scores

Daylighting and Views	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.062
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, and Daylighting and Views	.731 (p= .0033)	
Color Scheme	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.066
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, and Color Scheme	.735 (p= .0074)	
Location	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.099
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, and Location	.768 (p= .0081)	

Table 3 Continued: Regression Analysis of Third Grade Composite ITBS Scores

Instructional Neighborhoods	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.107
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, Location, and Instructional Neighborhoods	.776 (p= .0155)	
Outside Learning Areas	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.139
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, Location, Instructional Neighborhoods, and Outside Learning Areas,	.808(p= .0164)	

Table 3 Continued: Regression Analysis of Third Grade Composite ITBS Scores

Instructional Laboratories	Reduced	Percent Free Lunch, Experience, Percent White, and Percent Other	.669 (p= .0002)	0.142
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, Location, Instructional Neighborhoods, Outside Learning Areas, and Instructional Laboratories.	.811 (p= .0326)	

Comparison of ITBS Scores and Design Patterns

On Fifth Grade Composite Scores

The first step was to determine which of the possible control variables (free lunch, gifted, Hispanic, percent black, certificate level [T4 ,T5, T6, T7], average experience, percent white, and percent other) would be the best predictors of the fifth grade composite ITBS scores for the 24 schools. Backward elimination was used to determine when any variable would not add significantly to the prediction equation. The goal was to select the equation with the highest adjusted R Square. In Appendix D table 36 and 37 reveal an adjusted R square of .83482 ($F = 24.24910$; $p = .0000$), indicating that the R Square of .87073 was significantly different from "0". This equation included free lunch, certificate level (T4) average experience, percent white, and percent other (student population). Tables 36, 37, and 38 in Appendix D illustrate the results of the backward elimination process used to determine the best variables for the prediction equation.

Next the design variables were added one at a time to determine how much if any each addition would change the R Square (see table 4). Appendix E contains the results of the statistical tests that were used to determine the change in the R Square. Appendix E consists of tables 39 through 65.

Initially reduced regression models containing the correlative variables of percentage of students receiving free lunch, number of teachers with a T-4 certificate level, number of years of experience the teachers had, percentage of white students, and percentage of other students were calculated. Then in a stepwise fashion full regression models were calculated which included the criterion variable as well as the correlative variables in the reduced model. The difference in the R squares between the reduced

regression model and the full model containing the criterion variable is the change in the R Square that is attributed solely to the criterion variable of school design.

For the first criterion variable of movement, the reduced regression model calculated an R square value of .871. The full regression model calculated an R square value of .871. The difference between the reduced and full regression model is .000. Therefore, movement accounts for 0.0% of the variance (Table 4).. The calculations of these statistics are found in Appendix E in tables 39, 40, and 41.

Next, the second criterion variable was large group meeting spaces. For this criterion variable, the reduced regression model calculated an R square value of .871. The full regression model calculated an R square value of .902. The difference between the reduced and full regression model is .031. Therefore, movement and large group meeting places account for 3.1% of the variance. Thus, large group meeting places alone accounts for 3.1% of the variance. These results are found in Appendix E in tables 42, 43, and 44.

The third criterion variable was architectural design. For this, the reduced regression model calculated an R square value of .871. The full regression model calculated an R square value of .912. Therefore architectural design, large group meeting places, and movement accounts for 4.1% of the variance. Thus, architectural design alone accounted for 1.0% of the variance. These results are found in Appendix E in tables 45, 46, and 47.

For the fourth criterion variable of daylighting and views, the reduced regression model calculated an R square value of .871. The full regression model calculated an R square value of .930. The difference between the reduced and full regression model was

.059. Therefore daylighting and views, architectural design, large group meeting places, and movement accounts for 5.9% of the variance. Thus, daylighting and views alone account for 1.8% of the variance. These results are found in Appendix E in tables 48, 49, and 50.

For the fifth criterion variable of color scheme, the reduced regression model calculated an R square value of .871. The full regression model calculated an R square value of .932. The difference between the reduced and full regression model was .062. Therefore color scheme, daylighting and views, architectural design, large group meeting places, and movement accounts for 6.1% of the variance. Thus, color scheme alone accounts for .2% of the variance. These results are found in Appendix E in tables 51, 52, and 53.

The sixth criterion variable is location. The reduced regression model calculated an R square value of .871 for this criterion. The full regression model calculated an R square value of .933. The difference between the reduced and full regression model was .062. Therefore location, daylighting and views, color scheme, architectural design, large group meeting places, and movement accounts for 6.2% of the variance. Thus, location alone accounts for .1% of the variance. These results are found in Appendix E in tables 54, 55, and 56.

The reduced regression model calculated an R square value of .871 for the seventh criterion variable of instructional neighborhoods. The full regression model calculated an R square value of .938. The difference between the reduced and full regression model was .067. Therefore instructional neighborhoods, location, daylighting and views, color scheme, architectural design, large group meeting places, and movement

accounted for 6.7% of the variance. Thus instructional neighborhoods account for .5% of the variance. These results are found in Appendix E in tables 57, 58, and 59.

The eighth criterion variable was outside learning areas. The full regression model calculated an R square value of .944. The difference between the reduced and full regression model was .073. Therefore outside learning areas, instructional neighborhoods, location, daylighting and views, color scheme, architectural design, large group meeting places, and movement accounts for 7.3% of the variance. Thus, outside learning areas account for .6% of the variance. These results are found in Appendix E in tables 60, 61, and 62.

When instructional laboratories, the ninth criterion variable , was added the full regression model calculated an R square value of .968. The difference between the reduced and full regression model was .097. Therefore instructional laboratories, outside learning areas, instructional neighborhoods, location, daylighting and views, color scheme, architectural design, large group meeting places, and movement accounts for 9.7% of the variance. Thus, instructional laboratories account for 2.4% of the variance. These results are found in Appendix E in tables 63, 64, and 65.

Table 4 summarizes the change in R square as each design subscale is added one at a time to the analysis.

Table 4: Regression Analysis of Fifth Grade Composite ITBS Scores

Criterion Variable	Regression Model	Correlative Variable	R Square	Change in R Square Attributed to School Design Variable
Movement	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.000
	Full	Reduced and Movement	.871 (p= .0000)	
Large Group Meeting Places	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.031
	Full	Reduced, Movement, and Large Group Meeting Places	.902 (p= .0000)	
Architectural Design	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.041
	Full	Reduced, Movement, Large Group Meeting Places, and Architectural Design	.912 (p= .0000)	

Table 4 Continued: Regression Analysis of Fifth Grade Composite ITBS Scores

Daylighting and Views	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.059
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, and Daylighting and Views	.930 (p= .0000)	
Color Scheme	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.061
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, and Color Scheme	.932 (p= .0000)	
Location	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.062
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, and Location,	.933 (p= .0000)	

Table 4 Continued: Regression Analysis of Fifth Grade Composite ITBS Scores

Instructional Neighborhoods	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.067
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, Location, and Instructional Neighborhoods	.938 (p= .0001)	
Outside Learning Areas	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.073
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, Location, Instructional Neighborhoods, and Outside Learning Areas	.944 (p= .0001)	

Table 4 Continued: Regression Analysis of Fifth Grade Composite ITBS Scores

Instructional Laboratories	Reduced	Percent Free Lunch, T4, Experience, Percent White, and Percent Other	.871 (p= .0000)	.097
	Full	Reduced, Movement, Large Group Meeting Places, Architectural Design, Daylighting and Views, Color Scheme, Location, Instructional Neighborhoods, Outside Learning Areas, and Instructional Laboratories.	.968 (p=.0001)	

CHAPTER V

SUMMARY, CONCLUSIONS, CONCERNS, AND RECOMMENDATIONS

Introduction

This chapter includes a summary of the study. Conclusions and concerns about the study are stated and discussed. The chapter concludes with recommendations for further studies.

Summary of the Study

Research has indicated the need for massive school construction. Either new schools have to be built to replace the crumbling schools that are still in use, or these crumbling schools need to be completely renovated. Letting children continue to attend schools that are inadequate (and in some instances unsafe) is unfathomable. For this reason, the need to study the relationships of achievement and school design was extremely timely.

Based on the review of the literature climate control, noise level, and illumination have consistently affected student achievement levels (Herrington, 1952; McDonald 1960; Nolan, 1960; Peccolo, 1962; McCardle 1966; Stuart & Curtis, 1964; Chan 1980; Bronzaft & McCarthy, 1975; Cohen & Lezak, 1977; Woodhead, 1964; Tinker, 1939; Luckish & Moss, 1940; Chorlton & Davis 1959; Horton, 1972; Mayron, Ott, Nations, & Mayron, 1974).

The presence of windows had mixed results in this literature review. O'Connor (1999) and Harrington (1999) indicated that windows do affect the

achievement level of students, while Cooper (1964) and Romney (1975) indicated windows do not affect the achievement level of students.

Mixed results were also found during this review of the literature for color schemes. Rice (1953), Ketchan (1964), and "Blue is Beautiful" (1973) all indicated that the color scheme of the learning environments affected the achievement level of the students, while, Chan (1980) indicated that color scheme did not affect the students' achievement level.

In the review of the literature it was found that the condition of the building consistently affected student achievement (Chan, 1966; Burkead, Fox & Holland, 1967; Gingold, 1971; Guthrie, Kleindorfer, Levin, & Stout, 1971; McGuffey & Brown, 1978; Lezotte & Passalacqua, 1978; Plumley, 1978; Edwards, 1992; Bowers & Burkett, 1987; Cash, 1993; Earthman, Cash, & Berkum, 1995). Only one study was found that indicated no relationship between building condition and student achievement levels (Chan, 1979).

The purpose of this study was to determine if student achievement as measured by the third and fifth grade composite scores on the ITBS is affected by design factors of the school facility as measured by the DASE Version 2000 instrument.

The setting for this study was 24 elementary schools located in the west central Georgia RESA area. Site visits to each of the 24 schools was conducted and the DASE Version 2000 instrument was completed for each individual school. Data from the Georgia school report cards was then collected from the Internet. This data consisted of the control variables free lunch, gifted, percent Hispanic, percent black, certificate level (T4, T5, T6, T7), average experience, percent white, and percentage of other races. Backward elimination was used to determine the best prediction equation for the third

and fifth grade, separately. In each case, the goal was to select the equation with the highest adjusted R Square. The predication equation for the third grade included free lunch, average experience, percent white, and percent other (student population). The predication equation used with the fifth grade included free lunch, certificate level (T4) average experience, percent white, and percent other (student population).

Findings and Conclusions

The following conclusions were made after reviewing the results of the data in chapter IV.

1. It was found that 14.2% of the variance was accounted for in the design patterns for the third grade. Therefore, it may be concluded that these items (movement, architectural design, daylighting and views, color scheme, location, instructional neighborhoods, outside learning areas, and instructional laboratories) influence student learning.
2. The design pattern that accounted for the largest percentage of variance (3.5%) for the third grade was circulation pattern or movement. Add to this variance the variance for the location of the school (3.3%) and outdoor learning environments (3.2%) and a large chunk of the 14.2% variance is explained. The remaining 5 subscales account for the additional 4.2% of the explained variance.
3. Large group meeting places accounted for 0.0% of the variance in the third grade.
4. It was found that 9.7% of the variance was accounted for in the design patterns for the fifth grade. Therefore it may be concluded that these items (large group meeting places, architectural design, daylighting and views, color scheme,

location, instructional neighborhoods, outside learning areas, and instructional laboratories) influence student learning.

5. The design pattern that accounted for the largest percentage of variance (3.1%) for the fifth grade was large group meeting areas. The instructional laboratory design pattern design accounted for the next largest amount of variance at 2.4%.
6. Movement or circulation patterns accounted for 0.0% of the variance in the fifth grade.
7. It was found that the third and fifth grade students were affected by different design patterns.
8. There were only two design patterns that accounted for similar amounts of variance in both the third and fifth grade. The first one is the instructional neighborhood design pattern, which accounted for 0.8% of the variance in the third grade and 0.5% of the variance in the fifth grade. The second design pattern with similar results for both the third and fifth grade is the color scheme of the school which accounted for 0.4% of the variance in the third grade and 0.2% of the variance in the fifth grade.

Study Concerns

1. One rater may not adequately capture all of the nuances of a school's design.
2. Due to limited financial resources, only 24 schools were toured and included in this study.

3. Only the ITBS scores, cognitive measures of achievement, for the third and fifth grade were analyzed. No considerations were given to behavioral and affective variables.

Recommendations for Future Studies

1. Using the Design Appraisal Scale Elementary (DASE) Version 2000 the same study could be conducted again using a larger more varied sample.
2. Data may be more accurate if a team of raters scored each school using the DASE instrument.
3. Achievement scores for more than just third and fifth grades could be used in the analysis.
4. Individual subject area achievement scores could be used in the analysis.
5. Measures of the affective and behavioral domain of learning need to be addressed.

REFERENCES

Abramson, P. (1999). 1999 Construction Report. School Planning and Management, 38(2), 35-49.

Adams, L., & Zuckerman, D. (1991). The effect of lighting conditions on personal space requirements. Journal of General Psychology, 118(4), 335-340.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). A pattern language. New York: Oxford University Press.

Anderson, S. (1999). The relationship between school design variables and scores on the Iowa Test of Basic Skills. Unpublished doctoral dissertation, University of Georgia, Athens, Ga.

Ayers, P. (1999). Exploring the relationship between high school facilities and achievement of high school students in Georgia. Unpublished doctoral dissertation, University of Georgia, Athens, Ga.

Baker, K. (1998). Education construction projected to grow. AIArchitect. Retrieved April 26, 2000 from the World Wide Web: http://www.e-architect.com/news/aiarchitect/apr98/education.asp.

Bingler, S. (1995). Place as a form of knowledge. In A. Meek (Ed.), Designing places for learning, (pp. 23-30). Alexandria, VA: Association for Supervision and Curriculum Development.

Blue is beautiful. (1973, September 17). Time, 102 (3), 66.

Bowers, J.H., & Burkett, C.W. (1987). Relationship of student achievement and characteristics in two selected school facility environmental settings. (ERIC Document Reproduction Service No. ED 019674)

Bradley, W.S. (1998). Expecting the most from school design. Unpublished manuscript, Thomas Jefferson Center for Educational Design, University of Virginia, Charlottesville.

Bronzaft, A.L., & McCarthy, D.P. (1975). The effects of elevated train noise on reading ability. Environment and Behavior, 7(6), 517-527.

Brubaker, C.W. (1991). Lessons in high school planning and design. School Business Affairs, 57(1), 6-10.

Burkhead, J., Fox, T., & Holland, J.W. (1967). Input and output in large city high schools. Syracuse, NY: Syracuse University Press.

Cash, C. (1993). A study of the relationship between school building condition and student achievement and behavior. Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Castaldi, B. (1994). Educational facilities: Planning, modernization and management (4th ed.). Boston, MA: Allyn and Bacon, Inc.

Chan, T.C. (1979). The impact of school building age on pupil achievement. (ERIC Document Reproduction Service No. ED 012865)

Chan, T. C. (1980). Physical environment and middle grade achievement. (ERIC Document Reproduction Service No. ED 198645).

Chan, T.C. (1996). Environmental impact on student learning. (ERIC Document Reproduction Service No. ED 028032)

Chorlton, J.M., & Davidson, H.F. (1959). The effect of specular reflection on visibility: Part II- Field measurements of loss of contrast. Illuminating Engineering, 8, 482-488.

Cochran, C.D., Hale, D., & Hissam, C. (1984). Personal space requirements in indoor versus outdoor locations. Journal of Psychology, 117, 121-123.

Cohen, S., & Lezak, A. (1977). Noise and inattentiveness to social cues. Environment and Behavior, 9, 559-572.

Colven, R. (1990). The quality of the physical environment of the school and the quality of education. Conclusions of a seminar Lindingo, Sweden, 17-21 October 1988. (ERIC Document Reproduction Service No. ED 324791)

Cooper, J., & Ivey, C.H. (1964). A comparative study of the educational environment and the educational outcomes in an underground school, a windowless school and conventional schools. (ERIC Document Reproduction Service No. ED 011054)

Crumpacker, S.S. (1995). Using cultural information to create schools that work. In A. Meek (Ed.), Designing places for learning, (pp. 31-42). Alexandria, VA: Association for Supervision and Curriculum Development.

Curtis, P., & Smith, R. (1974). A child's exploration of space. School Review, 82, 671-680.

Day, C.W. (1999, July). Sounding off. American Schools and Universities. Retrieved April 26, 2000 from the World Wide Web: http://www.asumag.com/magazine/Archives/0799acoustics1.html

Don't be so casual about colors in your classrooms (1970). American School Board Journal, 157 (10), 32-33.

Duke, D.L. (1998). Does it matter where our children learn? (ERIC Document Reproduction Service No. ED 418578)

Earthman, G., Cash, C., & Berkum, D.V. (1995). A statewide study of student achievement and behavior and school building condition. (ERIC Document Reproduction Service No. ED387878)

Edwards, M. (1992). Building conditions, parental involvement, and student achievement in the DC Public School System. (ERIC Document Reproduction Service No. ED 338743)

Fanning Howey Associates (1997). Making a world of difference: Elementary schools: Impact on education series. Celina, OH: The Associates.

Feistritzer, C.E. (1996). Profile of teachers in the U.S. Washington, D.C.: National Center for Education Information.

Fiske, E.B. (1995). Systemic school reform: Implications for architecture. In A. Meek (Ed.), Designing places for learning, (pp.1-10). Alexandria, VA: Association for Supervision and Curriculum Development.

Gabrino, J. (1980). Some thoughts about school size and its effects on adolescent development. Journal of Youth and Adolescence, 9(1), 19-31.

Garrett, H. E., & Woodworth, R. S. (1958). Statistics in psychology and education. New York: David McKay Company, Inc.

Georgia Department of Education (1999). School report cards. Retrieved September 20, 2000 from the World Wide Web: http://www.doe.k12.ga.us

Gingold, W. (1971). The effects of physical environment on children's behavior in the classroom. (ERIC Document Reproduction Service No. ED 120942)

Graves, B.E. (1993). School ways: The planning and design of America's schools. New York McGraw-Hill, Inc.

Grocoff, P.N. (1995). Electric lighting and daylighting in schools. Council of Educational Facility Planners, International Issue Track. Retrieved January 1, 2000 from the World Wide Web: http://www.cefpi.com/issue1.html

Halsted, H. (1992). Designing facilities for a generation of schools. Educational Technology, 32(10), 46-48.

Hansen, S.J. (1992). Schoolhouse in the red. A guide book for cutting our losses: Powerful recommendations for improving America's school facilities. Arlington, VA: American Association of School Administrators.

Harrigan, M. (1999). Plugging into energy savings. The American School Board Journal, 186(1), 12-16.

Hebert, E.A. (1998). Design Matters: How school environment affects children. Educational Leadership, 56(1). Retrieved January 22, 2000 from the World Wide Web: http://www.ascd.org/pubs/ed/sep98/hebert.html.

Herrington, L.P. (1952). Effects of thermal environment on human action. American School and University, 24, 367-376.

Honeyman D.S. (1998). The condition of America's schools. School Business Affairs, 64(1), 8-16.

Horton, C.D. (1972). Humanization of the learning environment. (ERIC Document Reproduction Servie No. ED 066929)

Keller, B. (1999, February 17). School construction in U.S. tops $15 billion. Education Week, 18(23), 6. Retrieved April 26, 2000 from the World Wide Web: http://www.edweek.org/ew/1999/23build.h.18

Ketcham, J. (1964). These colors fit your school décor. Nations Schools, 74(5), 61-80.

Kozol, J. (1991). Savage inequities: Children in American schools. New York: Harper Perennial.

Kuller, R., & Lindsten, C. (1992). Health and behavior of children in classrooms with and without windows. Journal of Environmental Psychology, 12, 305-317.

Kyzar, B. (1977). Noise pollution in schools: How much is too much? Council of Educational Facility Planners, International Journal, 15(2), 10-11.

Lang, D. (1996). Essential criteria for an ideal learning environment. Center for Environment, Education and Design Studies. Retrieved April 25, 2000 from the World Wide Web: http://www.newhorizons.org/article_dalelang.html.

Latham, A.S. (1999). Computers and achievement. Educational Leadership, 56(5), 87-88.

Lezotte, L.W., & Passalacqua, J. (1978). Individual school buildings do account for differences in measured pupil performance. (ERIC Document Reproduction Service No. ED 164695)

Lomranz, J., Shapira, A., Choresh, N., & Gilat, Y. (1975). Children's personal space as a function of age and sex. Developmental Psychology, 11, 541-545.

Luckiesh, M., & Moss, F. K. (1940). Effects of classroom lighting upon educational progress and visual welfare of school children. Illumination Engineering, 35, 915-938.

Lyons, J.B. (1999). K-12 school construction facts: April 1999. U.S. Department of Education, NCES. Retrieved April 26, 2000 from the World Wide Web: http://edfacilities.org/ne/news5.html.

Mack, D. (1976). Privacy: A child's need to be alone in the classroom. Teacher, 93(6), 52-53.

Mayron, L., Ott, J., Nations, R., & Mayron, E. (1974). Light, radiation and academic behavior. Academic Therapy, 10(1), 33-48.

McAllister, P. (1998). Education appropriations. Capital News di Views: A Bimonthly Report from the State and Federal Relations Office of ETS, 1. Princeton, N.J.: State and Federal Relations Office of ETS.

McCardle, R.W. (1966). Thermal environment and learning. Unpublished doctoral dissertation, University of Iowa, Des Moines, IA.

McDonald, E.G. (1960). Effect of school environment on teacher and student performance. Air Conditioning, Heating and Ventilating, 57, 78-79.

McGuffey, C. W., and Brown, C. L. (1978). The impact of school building age on school achievement in Georgia. Council of Educational Facility Planners, International Journal, 16(1), 6-9.

Moore, D.P. (1998). Where children learn: The effect of facilities on student achievement. Council of Educational Facility Planners, International Issue Track. Retrieved January 24, 2000 from the World Wide Web: http://www.cefpi.org/issue/issue8.html.

Moore, G.T., Lane, C.G., Hill, A.B., Cohen, U., & McGinty, T. (1979). Recommendations for child care centers. In C. S. Weinstein & T. G. David (Eds.), Spaces for children: The built environment and child development, (163-186). New York: Plenum Press.

National Center for Educational Statistics (1999, February). How old are America's schools? 1998 Digest, CCD, Issue Brief.

Nolan, J.A. (1960). Influence of classroom temperature on academic learning. Automated Teaching Bulletin, 1,12-20.

Norusis, N.J. (1990). SPSS Base System User's Guide. Chicago, IL: SPSS, Inc.

O'Connor, M.J. (1999). Study shows grades improve in daylit spaces. The AIA Journal, 88(8), 31.

Peccolo, M. (1962). The effect of thermal environment on learning. Tennessee Education, 1(1), 36-39.

Plath, K. (1965). Schools within schools: A study of high school organization. New York: Teachers College, Columbia University.

Plumley, J.P. Jr. (1978). The impact of school building age on the academic achievement of pupils from selected schools in the state of Georgia. Unpublished doctoral dissertation, University of Georgia, Athens, GA.

Proshansky, E., & Wolfe, M. (1974) The physical setting and open education. School Review, 82, 557-574.

Ravitch, D. (1998). The great technology mania. Forbes, 161(6), 134.

Review of the psychological reaction to windows (1978). Council of Educational Facility Planners, International Journal, 16(6), 9-10.

Rice, A.J. (1953). What research knows about color in the classroom. Nation's Schools, 52(5), 1-8.

Romney, B.M. (1975). The effects of windowless classrooms on the cognitive and affective behavior of elementary school students. (ERIC Document Reproduction Service No. ED 008565)

Rydeen, J.E. (1993). Designs for learning. American School Board Journal, 180(4), 34-36.

Savinar, J. (1975). The effects of ceiling height on personal space. Man-Environment Systems, 5(5), 321-324.

Scott, E. (1999). Sound Decisions improve learning. American Schools and Universities, Retrieved April 26, 2000 from the World Wide Web: http://www.asumag.com/magazine/Archives/1199acoustics.html

Sleeman, P.J., & Rockwell, D.M. (1981). Designing learning environments. New York: Longman.

Smith, N.R. (1980). Color selection--a key element in learning. Council of Educational Facility Planners, International Journal, 18(2), 6-7.

Stine, S. (1997). Landscapes for learning. New York: John Wiley and Sons, Inc.

Stuart, F., & Curtis, H.A. (1964). A digest of climate controlled and non-climate controlled schools--An evaluative study conducted in Pinellas County Florida. (ERIC Document Reproduction Service No. ED 001128)

Tanner, C.K. (1999). A design assessment scale for elementary schools. (ERIC Document Reproduction Service No. ED 429433)

Tanner, C. K. (2000). The influence of school architecture on academic achievement. Journal of Educational Administration, 38(4), 309-330.

Taylor. A. (1995) How schools are redesigning their space. In A. Meek (Ed.), Designing places for learning, (pp. 67-70). Alexandria, VA: Association for Supervision and Curriculum Development.

Taylor, A., Aldrich, R.A., & Vlastos, G. (1988). Architecture can teach. In Context, 18, Winter 1988. Retrieved September 14, 1999 from the World Wide Web: http://www.context.org/ICLIB/IC18/Taylor.htm

Tinker, M.A. (1939). The effect of illumination intensities upon speed of perception and upon fatigue in reading. The Journal of Educational Psychology, 30(8), 561-571.

Thomas, A. (1962). Efficiency in education: A study of the relationship between selected inputs and mean test scores in a sample of senior high schools. Unpublished doctoral dissertation, Stanford University, California.

Valiant, B. (1996). Turn on the lights! Using what we know about the brain and learning to design learning environments. Council of Educational Facility Planners, International Issue Track. Retrieved January 24, 2000 from the World Wide Web: http:///www.cefpi.org/issue5.html

Wenglinsky, H. (1998). Does it compute? The relationship between educational technology and student achievement in mathematics. (ERIC Document Reproduction Service No. ED 425191)

White, M.J. (1975). Interpersonal distance as affected by room size, status, and sex. Journal of Psychology, 95, 241-249.

Witcher, A. (1991). School facilities - From elemental to exemplary. Education Facility Planner, 29, 12-16.

Woodhead, M. (1964). The effect of bursts of noise on an arithmetic task. American Journral of Psychology, 77, 627-633.

APPENDIX A

Table 5: Raw Data from the DASE and Information Gathered from the Georgia Report Card-- Subscale Movement Patterns

	Var 1	Var 2	Var 3	Var 4	Var 5	Var 6	Var 7	Var 8	Var 9	Var 10	Var 11	Var 12	Var 13	Var 14	Var 15	Var 16	Var 17
School # 1	8	10	5	10	8	9	4	10	10	10	10	10	10	10	5	10	0
School # 2	9	9	8	10	10	7	10	10	10	10	10	10	10	10	10	10	4
School # 3	7	8	10	10	10	6	2	10	10	10	10	10	10	10	10	6	0
School # 4	4	6	8	10	10	9	6	10	10	10	10	10	10	10	10	8	0
School # 5	9	8	8	10	10	10	10	0	10	10	10	10	10	10	10	0	0
School # 6	7	7	7	10	7	10	2	10	10	10	10	10	10	10	10	10	0
School # 7	5	8	6	10	10	8	3	10	10	10	10	10	10	10	5	10	0
School # 8	6	7	6	10	10	6	0	7	10	10	0	10	10	10	6	10	0
School # 9	7	7	8	10	10	8	0	10	10	4	10	10	10	10	8	8	0
School # 10	10	10	7	10	7	10	10	10	10	10	10	10	10	10	10	10	10
School # 11	6	8	7	10	10	7	0	8	10	10	10	10	10	10	10	10	0
School # 12	4	8	7	10	9	7	0	10	10	10	10	10	10	10	10	10	0
School # 13	6	7	10	10	8	5	0	10	10	10	4	10	10	10	10	4	0
School # 14	3	6	10	10	8	5	0	10	10	10	5	10	10	10	10	4	0
School # 15	10	10	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10
School # 16	8	8	7	10	10	6	0	5	5	10	10	10	5	5	10	10	0
School # 17	8	7	8	10	10	6	0	10	10	10	10	10	10	10	10	10	0
School # 18	8	8	5	10	10	6	0	10	10	10	10	10	10	10	10	10	0
School # 19	10	10	8	10	10	7	3	10	10	10	10	10	10	10	10	10	0
School # 20	10	10	8	10	8	5	0	0	10	10	10	10	10	10	10	10	0
School # 21	9	8	8	10	10	8	0	10	10	10	10	10	10	10	10	10	0
School # 22	2	5	5	10	10	5	2	10	10	10	10	10	10	10	10	10	0
School # 23	10	9	8	10	10	7	0	10	10	10	10	10	10	10	10	10	0
School # 24	10	7	7	10	10	8	0	10	10	10	10	10	10	10	10	10	0

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card --Subscale for Large Group Meeting Place and Subscale for Architectual Design

	Var 18	Var 19	Var 20	Va 21	Var 22	Var 23	Var 24	Var 25		Var 26	Var 27	Var 28	Var 29	Var 30	Var 31	Var 32	Var 33	Var 34
School # 1	0	0	7	0	0	4	0	8		4	10	7	4	3	10	2	8	1
School # 2	0	0	7	7	10	0	0	5		7	8	6	3	4	10	5	10	0
School # 3	0	0	8	0	0	0	0	5		4	10	6	3	4	10	0	8	0
School # 4	0	0	8	0	0	3	6	8		2	10	7	4	3	10	4	9	0
School # 5	0	0	8	3	0	1	0	6		5	10	8	4	5	10	6	10	3
School # 6	0	0	8	0	0	0	0	6		8	10	6	5	4	10	2	8	2
School # 7	0	0	7	0	0	0	0	5		4	10	6	0	6	7	2	7	8
School # 8	0	0	3	0	0	0	0	2		2	10	3	0	3	10	0	9	2
School # 9	0	0	7	0	0	4	0	6		4	10	7	7	3	8	4	8	2
School # 10	0	0	10	8	0	7	2	8		7	6	9	6	8	10	10	8	10
School # 11	0	0	6	0	0	0	0	5		6	10	7	6	6	8	4	7	1
School # 12	0	10	6	0	0	0	0	6		6	9	4	6	3	10	3	7	2
School # 13	0	0	10	0	0	4	0	7		8	10	9	9	7	10	4	8	0
School # 14	0	0	10	0	0	10	0	8		6	8	6	8	7	10	5	7	0
School # 15	0	0	8	0	0	4	0	7		9	10	10	4	10	10	2	9	10
School # 16	10	0	7	0	10	1	0	5		6	5	10	1	6	10	10	9	0
School # 17	0	0	7	0	0	1	0	6		6	10	8	6	4	10	3	9	2
School # 18	0	10	7	0	0	1	0	5		3	10	7	4	3	8	2	10	2
School # 19	0	0	8	0	0	3	3	6		9	10	8	9	7	10	3	9	0
School # 20	10	0	10	10	8	3	0	0		6	10	10	4	5	10	10	8	0
School # 21	0	0	10	0	0	1	0	8		9	10	6	9	9	10	5	6	1
School # 22	0	0	6	0	0	4	1	5		2	10	6	3	3	8	3	9	0
School # 23	7	0	6	0	10	1	0	5		4	10	8	10	3	2	2	10	3
School # 24	10	0	6	0	0	1	0	6		6	10	8	6	6	10	5	9	1

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card --Subscale for Daylighting and Views, Subscale for Color Scheme, and Subscale for Building on Student's Scale

	Var 35	Var 36	Va 37	Var 38	Var 39		Var 40	Var 41	Var 42	Var 43	Var 44	Var 45		Var 46	Var 47	Var 48	Var 49	Var 50	Var 51	Var 52
School # 1	7	6	6	5	5		4	4	6	5	0	4		0	5	0	0	10	7	10
School # 2	7	4	6	6	4		5	8	9	5	6	2		2	5	0	0	10	6	10
School # 3	2	2	3	4	3		8	5	8	5	5	7		0	5	0	0	10	4	10
School # 4	4	6	4	3	3		5	6	9	7	3	5		0	5	0	0	5	6	10
School # 5	6	8	7	4	7		5	8	10	5	10	10		5	5	0	0	10	6	4
School # 6	4	3	5	2	7		5	10	10	10	10	10		0	5	10	0	10	5	10
School # 7	2	4	7	4	7		4	9	9	5	3	3		2	5	0	0	8	3	8
School # 8	2	2	1	1	3		2	7	4	4	2	2		0	5	0	0	5	3	7
School # 9	4	5	4	4	7		7	7	8	5	5	6		0	5	0	0	10	4	3
School # 10	7	2	8	6	7		5	5	6	5	3	10		0	5	10	0	10	6	7
School # 11	5	3	6	3	6		5	10	7	5	9	8		0	5	0	0	10	5	5
School # 12	5	4	5	3	4		5	8	5	5	7	8		0	5	5	10	10	5	10
School # 13	6	8	2	8	8		5	10	7	7	8	6		0	5	0	0	10	4	10
School # 14	4	5	2	4	5		5	7	6	6	8	8		0	5	0	0	10	4	10
School # 15	8	7	9	7	10		5	5	10	5	8	8		0	5	0	0	10	7	5
School # 16	7	4	6	3	9		6	6	8	6	3	10		8	5	5	0	10	10	10
School # 17	7	6	6	6	7		8	8	8	7	6	6		0	5	0	0	10	10	5
School # 18	6	5	4	4	6		5	7	10	10	6	7		0	5	5	5	5	5	5
School # 19	8	7	7	7	6		5	10	10	10	10	10		0	5	0	5	10	8	10
School # 20	8	5	7	8	8		6	5	6	6	3	3		0	5	5	0	10	6	10
School # 21	9	9	6	8	6		5	10	10	10	10	10		5	5	0	0	10	6	2
School # 22	5	8	4	2	6		5	5	10	6	4	8		0	5	0	0	10	8	5
School # 23	8	6	5	7	8		7	10	10	10	10	10		0	5	5	0	10	10	5
School # 24	5	7	8	7	8		5	7	6	6	10	10		0	5	0	0	10	7	5

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card--Subscale for Location of the School

	Var 53	Var 54	Var 55
School # 1	7	8	5
School # 2	3	5	3
School # 3	3	5	6
School # 4	3	3	4
School # 5	9	7	2
School # 6	2	7	6
School # 7	7	4	3
School # 8	7	4	4
School # 9	8	7	5
School # 10	10	9	5
School # 11	5	5	4
School # 12	9	6	6
School # 13	10	8	10
School # 14	9	6	4
School # 15	7	8	7
School # 16	8	7	4
School # 17	6	8	5
School # 18	9	6	2
School # 19	10	10	10
School # 20	10	8	6
School # 21	8	10	8
School # 22	3	4	2
School # 23	7	7	4
School # 24	6	8	5

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card--Subscale for Instructional Neighborhoods

	Var 56	Var 57	Var 58	Var 59	Var 60	Var 61	Var 62	Var 63	Var 64	Var 65	Var 66	Var 67	Var 68	Var 69	Var 70	Var 71
School # 1	0	2	2	10	4	4	0	0	2	2	7	0	0	6	5	10
School # 2	0	1	0	10	6	6	0	0	2	6	10	4	4	3	4	10
School # 3	0	2	0	10	4	4	0	0	2	2	10	0	0	5	8	10
School # 4	0	1	0	10	4	4	0	3	1	3	10	0	1	7	10	10
School # 5	0	0	0	10	8	8	0	0	1	3	9	2	1	7	8	10
School # 6	0	0	0	10	10	10	0	4	3	3	10	8	3	7	8	10
School # 7	0	0	0	10	3	3	0	2	0	6	7	0	0	3	5	10
School # 8	0	0	4	10	0	0	0	3	2	3	3	5	5	3	0	10
School # 9	0	0	4	10	0	0	0	5	0	2	8	5	5	6	0	10
School # 10	10	2	0	10	4	4	0	0	1	7	10	1	2	6	10	10
School # 11	0	0	3	10	6	6	0	0	2	6	8	10	9	6	7	10
School # 12	0	0	0	10	3	3	0	4	1	4	8	7	0	6	4	10
School # 13	0	0	5	10	0	0	0	10	0	3	10	8	8	9	4	10
School # 14	0	1	8	10	1	1	0	10	0	3	10	10	10	10	7	10
School # 15	0	1	0	10	6	6	0	0	3	2	10	2	0	8	10	10
School # 16	0	0	0	10	5	5	0	0	0	8	10	0	1	3	5	10
School # 17	0	0	0	10	7	7	0	0	0	7	8	0	0	4	4	10
School # 18	0	0	0	10	0	0	0	0	0	8	6	0	0	4	3	10
School # 19	0	0	0	10	8	8	0	0	0	7	10	7	7	7	8	10
School # 20	0	0	0	10	10	10	0	0	0	9	10	0	0	5	8	10
School # 21	0	0	0	10	7	7	0	0	0	6	10	6	6	6	5	10
School # 22	1	0	0	10	5	5	0	0	2	5	8	2	2	3	7	10
School # 23	0	0	0	10	3	3	0	0	1	10	8	0	2	5	6	10
School # 24	0	0	0	10	10	10	0	0	0	8	10	2	0	6	5	10

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card--Subscale for Outside Learning Environment, Subscale for Instructional Laboratories, and Subscale for Environmental Conditions.

	Var 72	Var 73	Va 74	Var 75	Var 76	Var 77		Var 78	Var 79	Var 80	Var 81	Var 82	Var 83		Var 84	Var 85	Var 86
School # 1	7	7	4	8	4	6		5	7	0	10	8	8		10	9	8
School # 2	6	6	8	8	6	4		9	7	3	4	0	0		9	7	8
School # 3	3	2	7	7	6	1		5	10	0	0	0	0		9	8	9
School # 4	5	5	8	8	4	2		7	2	7	0	0	0		10	8	10
School # 5	2	0	0	4	6	0		10	10	2	10	0	0		9	7	9
School # 6	0	0	7	4	6	1		5	10	8	0	0	0		5	6	8
School # 7	2	0	0	2	1	2		0	8	0	2	3	0		7	7	8
School # 8	0	0	0	0	4	1		10	0	0	0	0	0		4	7	6
School # 9	0	0	0	2	5	0		6	0	0	0	0	0		9	3	8
School # 10	0	0	2	8	8	2		8	7	8	9	2	10		6	6	9
School # 11	2	2	0	4	2	7		7	7	0	6	1	0		8	5	9
School # 12	3	3	0	3	8	7		6	6	0	8	0	0		7	5	9
School # 13	9	8	10	10	8	8		4	3	0	7	0	0		8	7	10
School # 14	3	0	0	3	5	8		10	3	0	3	5	0		8	8	8
School # 15	0	0	0	9	8	0		4	10	8	8	8	0		10	3	4
School # 16	0	0	0	6	2	1		7	10	10	7	0	0		10	10	7
School # 17	0	0	0	3	6	2		0	10	10	8	10	8		10	3	8
School # 18	6	4	7	7	8	2		0	6	0	8	0	2		7	10	8
School # 19	7	8	10	8	10	10		0	9	6	8	10	6		5	10	8
School # 20	0	0	8	9	8	4		10	4	10	10	9	0		5	7	8
School # 21	7	7	8	7	7	4		0	8	6	8	6	0		7	10	9
School # 22	0	0	0	0	2	2		0	10	8	10	10	5		7	10	6
School # 23	5	5	8	8	10	3		0	4	10	10	0	2		10	10	4
School # 24	4	6	4	10	10	3		0	8	10	10	0	10		10	10	8

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card--Ethnic breakdown of students enrolled.

	Black	White	Hispanic	Asian	Am. Indian	Multiracial	Total
School # 1	152	339	2	2	0	2	497
School # 2	148	347	3	3	1	5	507
School # 3	280	74	3	1	0	0	358
School # 4	58	438	4	6	0	0	506
School # 5	72	734	15	3	0	12	836
School # 6	60	477	2	0	0	0	539
School # 7	116	577	6	0	1	6	706
School # 8	201	40	0	0	0	3	244
School # 9	435	83	2	0	0	0	520
School # 10	728	859	53	20	1	48	1709
School # 11	77	481	5	5	0	7	575
School # 12	166	631	2	4	6	20	829
School # 13	33	364	4	0	0	3	404
School # 14	46	317	0	0	1	2	366
School # 15	221	342	7	0	0	2	572
School # 16	189	180	2	0	0	1	372
School # 17	198	190	0	0	0	3	391
School # 18	221	166	3	0	0	6	396
School # 19	165	289	7	1	0	7	469
School # 20	210	290	8	2	1	7	518
School # 21	152	291	2	1	1	9	456
School # 22	217	217	4	2	3	11	454
School # 23	236	246	1	0	0	4	487
School # 24	202	193	4	0	1	12	412

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card--Percentage of gifted students, Percentage of free/reduced lunch, ITBS scores for the 3rd and 5th grade, Type of certificate held by the staff members

			ITBS Scores		Certificated Staff			
	Gifted	Free/Reduced Lunch	3rd Grade Composite	5th Grade Composite	T-4	T-5	T-6	T-7
School # 1	50	41%	57	64	15	15	2	0
School # 2	69	24.20%	72	72	15	9	6	0
School # 3	18	75.1	60	37	13	13	5	0
School # 4	20	32.10%	60	56	12	15	6	0
School # 5	50	20.3	62	64	21	22	1	0
School # 6	17	32.10%	59	68	21	9	3	0
School # 7	12	57.30%	54	60	21	18	5	0
School # 8	0	93.50%	27	33	11	6	2	0
School # 9	7	95.90%	29	24	21	17	3	0
School # 10	86	49.70%	44	58	52	43	15	0
School # 11	0	56.30%	34	43	17	12	7	1
School # 12	67	44.70%	43	51	17	19	12	1
School # 13	40	43.70%	52	49	10	16	3	1
School # 14	17	53.00%	33	41	14	11	3	0
School # 15	20	54.80%	70	53	19	18	3	0
School # 16	14	62.50%	56	57	13	12	2	0
School # 17	19	54.30%	47	59	13	12	3	1
School # 18	21	62.70%	35	51	13	13	4	0
School # 19	25	45.60%	48	54	14	17	3	0
School # 20	49	41.10%	63	62	16	19	5	0
School # 21	47	47.30%	63	57	14	15	4	0
School # 22	6	57.00%	51	48	12	16	5	0
School # 23	18	74.50%	33	38	8	25	6	0
School # 24	7	73.70%	35	32	9	16	4	0

Table 5 Continued: Raw Data from the DASE and Information Gathered from the Georgia Report Card--Average years of experience by the certified staff.

	Average Years of Experience					
	<1	1---10	11---20	21---30	>30	Average
School # 1	0	11	10	10	1	15.66
School # 2	3	9	11	7	0	12.37
School # 3	2	14	6	8	1	12.55
School # 4	3	12	7	11	0	13.64
School # 5	2	27	10	5	0	9.23
School # 6	2	15	11	5	0	11.24
School # 7	4	11	14	13	2	15
School # 8	0	6	7	4	2	15.16
School # 9	2	18	14	5	2	12.63
School # 10	14	43	33	18	2	11.66
School # 11	5	11	15	6	0	11.76
School # 12	6	18	11	14	0	12.06
School # 13	2	13	7	7	1	12.93
School # 14	6	10	6	5	1	11.04
School # 15	0	21	7	10	2	13.08
School # 16	2	10	8	7	0	13.44
School # 17	0	20	6	3	0	9.83
School # 18	1	9	16	4	0	13.87
School # 19	1	13	14	5	1	13.21
School # 20	1	17	13	7	2	13.83
School # 21	4	13	7	7	2	13.3
School # 22	4	11	7	11	0	14.06
School # 23	1	16	11	11	0	13.18
School # 24	0	13	11	4	1	13.17

APPENDIX B

Results for the 3rd grade

Table 6: Model Summary

Multiple R	.81794
R Square	.66902
Adjusted R Square	.59934
Standard Error	8.44907

Table 7: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	4	2741.60849	685.40212	9.60124	.0002
Residual	19	1356.34985	71.38683		

Table 8: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	Std. Error	Beta	t	Sig. t
(Constant)	101.322279	22.155339		4.573	.0002
FREELUN	-.911870	.164161	-1.304650	-5.555	.0000
AVEXPERI	1.832182	1.211793	.211436	1.512	.1470
PCTWHITE	-35.707318	13.196100	-.607266	-2.706	.0140
PCTOTHER	-206.812350	116.825601	-.247914	-1.770	.0927

APPENDIX C

3rd Grade Variables

Variable(s) Entered on Step Number
1. MOVEMENT
2. PCTWHITE
3. AVEXPERI
4. PCTOTHER
5. FREELUNCH

Table 9: Model Summary

Multiple R	.83905
R Square	.70400
Adjusted R Square	.62178
Standard Error	8.20903

Table 10: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	5	2884.97260	576.99452	8.56226	.0003
Residual	18	1212.98573	67.38810		

Table 11: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	62.455431	34.255421		1.823	.0849
FREELUN	-.833941	.168208	-1.193154	-4.958	.0001
AVEXPERI	1.933160	1.179398	.223089	1.639	.1186
PCTWHITE	-30.804715	13.254457	-.523889	-2.324	.0320
PCTOTHER	-253.501669	117.933754	-.303882	-2.150	.0454
MOVEMENT	.228067	.156363	.213816	1.459	.1619

Variable(s) Entered on Step Number
1. MEETING
2. PCTOTHER
3. AVEXPERI
4. PCTWHITE
5. MOVEMENT
6. FREELUNC

Table 12: Model Summary

Multiple R	.83906
R Square	.70402
Adjusted R Square	.59956
Standard Error	8.44674

Table 13: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	6	2885.05245	480.84208	6.73945	.0009
Residual	17	1212.90588	71.34740		

Table 14: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	62.494072	35.266297		1.772	.0943
FREELUN	-.833428	.173758	-1.192419	-4.7969	.0002
AVEXPERI	1.927468	1.225421	.222432	1.573	.1342
PCTWHITE	-30.686865	14.085896	-.521885	-2.179	.0437
PCTOTHER	-253.150497	121.802018	-.303461	-2.078	.0531
MOVEMENT	.229041	.163505	.214730	1.401	.1793
MEETING	-.013381	.399992	-.004884	-.033	.9737

Variable(s) Entered on Step Number

1. DESIGN
2. PCTWHITE
3. MOVEMENT
4. AVEXPERI
5. PCTOTHER
6. MEETING
7. FREELUNC

Table 15: Model Summary

Multiple R	.855424
R Square	.72972
Adjusted R Square	.61148
Standard Error	8.32008

Table 16: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	7	2990.37950	427.19707	6.17126	.0013
Residual	16	1107.57883	69.22368		

Table 17: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	52.805074	35.614458		1.483	.1576
FREELUN	-.822288	.171390	-1.176482	-4.798	.0002
AVEXPERI	2.337294	1.251937	.269726	1.867	.0803
PCTWHITE	-30.785155	13.874901	-.523556	-2.219	.0413
PCTOTHER	-285.722860	122.847144	-.342507	-2.326	.0335
MOVEMENT	.205044	.162223	.192232	1.264	.2243
MEETING	-.296845	.456114	-.108349	-.651	.5244
DESIGN	.342211	.277428	.221379	1.234	.2352

Variable(s) Entered on Step Number

1. DAYLIGHT
2. PCTWHITE
3. AVEXPERI
4. PCTOTHER
5. MEETING
6. MOVEMENT
7. DESIGN
8. FREELUNC

Table 18: Model Summary

Multiple R	.855487
R Square	.73081
Adjusted R Square	.58724
Standard Error	8.57567

Table 19: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	8	2994.82544	374.35318	5.09032	.0033
Residual	15	1103.13290	73.54219		

Table 20: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	55.294516	38.079269		1.452	.1671
FREELUN	-.822059	.176658	-1.176153	-4.653	.0003
AVEXPERI	20269658	1.319391	.261921	1.720	.1059
PCTWHITE	-30.734469	14.302632	-.522694	-2.149	.0484
PCTOTHER	-289.046851	127.340737	-.346492	-2.270	.0384
MOVEMENT	.185483	.185169	.173893	1.002	.3324
MEETING	-.272171	.480718	-.099343	-.566	.5796
DESIGN	.279115	.384214	.180562	.726	.4787
DAYLIGHT	.071840	.292184	.055767	.246	.8091

Variable(s) Entered on Step Number

1. COLOR
2. PCTOTHER
3. MEETING
4. FREELUNC
5. MOVEMENT
6. AVEXPERI
7. DAYLIGHT
8. DESIGN
9. PCTWHITE

Table 21: Model Summary

Multiple R	.85752
R Square	.73533
Adjusted R Square	.56519
Standard Error	8.80175

Table 22: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	9	3013.36609	334.81845	4.32186	.0074
Residual	14	1084.59224	77.47087		

Table 23: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	57.768887	39.409073		1.466	.1648
FREELUN	-.796677	.188592	-1.139838	-4.224	.008
AVEXPERI	1.973469	1.483359	.227740	1.330	.2047
PCTWHITE	-28.430774	15.416494	-.483516	-1.844	.0864
PCTOTHER	-301.600459	133.193125	-.361540	-2.264	.0400
MOVEMENT	.206416	.194807	.193518	1.060	.3073
MEETING	-.325160	.5.5141	-.118684	-.644	.5302
DESIGN	.312509	.400207	.202165	.781	.4479
DAYLIGHT	.084481	.300998	.065579	.281	.7831
COLOR	-.122225	.249843	-.085855	-.489	.6323

Variable(s) Entered on Step Number
1. LOCATION
2. PCTWHITE
3. MOVEMENT
4. AVEXPERI
5. PCTOTHER
6. MEETING
7. COLOR
8. DAYLIGHT
9. FREELUNC
10. DESIGN

Table 24: Model Summary

Multiple R	.87656
R Square	.76835
Adjusted R Square	.59016
Standard Error	8.54532

Table 25: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	10	3148.66529	314.86653	4.31191	.0081
Residual	13	949.29304	73.02254		

Table 26: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	52.465672	38.458773		1.364	.1957
FREELUN	-.783985	.183335	-1.121679	-4.276	.0009
AVEXPERI	2.640911	1.521328	.304764	1.736	.1062
PCTWHITE	-31.055503	15.091047	-.528154	-2.058	.0602
PCTOTHER	-305.611761	129.346236	-.366349	-2.363	.0602
MOVEMENT	.161161	.192032	.192032	.839	.4165
MEETING	-.292315	.491017	-.106696	-.595	.5618
DESIGN	.708413	.485349	.458278	1.460	.1681
DAYLIGHT	.101354	.292491	.078677	.347	.7345
COLOR	-.059647	.246883	-.041898	-.242	.8129
LOCATION	-.755234	.554833	-.305338	-1.361	.1966

Variable(s) Entered on Step Number
1. INSTRUCT
2. MOVEMENT
3. LOCATION
4. PCTOTHER
5. AVEXPERI
6. FREELUNC
7. COLOR
8. MEETING
9. DAYLIGHT
10. PCTWHITE
11. DESIGN

Table 27: Model Summary

Multiple R	.88082
R Square	.77584
Adjusted R Square	.57036
Standard Error	8.74924

Table 28: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	11	3179.36866	289.03351	3.77579	.0155
Residual	12	918.58967	76.54914		

Table 29: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	51.684006	39.395838		1.312	.2141
FREELUN	-.750588	.194976	-1.073897	-3.850	.0023
AVEXPERI	2.613490	1.558233	.301600	1.677	.1193
PCTWHITE	-25.891765	17.470462	-.440335	-1.482	.1641
PCTOTHER	-284.391645	136.605651	-.340911	-2.082	.0594
MOVEMENT	.191426	.202338	.179465	.946	.3628
MEETING	-.287987	.502780	-.105116	-.573	.5774
DESIGN	1.052090	.735812	.680606	1.430	.1783
DAYLIGHT	-.060770	.393972	-.047173	-.154	.8800
COLOR	-.019821	.260479	-.013923	-.076	.9406
LOCATION	-.863109	.593060	-.348952	-1.455	.1712
INSTRUCT	-.209346	.330554	-.201803	-.633	.5384

Variable(s) Entered on Step Number

1. OUTSIDE
2. PCTOTHER
3. AVEXPERI
4. MEETING
5. PCTWHITE
6. MOVEMENT
7. DAYLIGHT
8. COLOR
9. INSTRUCT
10. LOCATION
11. FREELUNC
12. DESIGN

Table 30: Model Summary

Multiple R	.89890
R Square	.80802
Adjusted R Square	.59860
Standard Error	8.45689

Table 31: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	12	3311.2490	275.93742	3.85824	.0164
Residual	11	786.70927	71.51902		

Table 32: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	25.538475	42.670345		.599	.5616
FREELUN	-.840936	.199861	-1.203161	-4.208	.0015
AVEXPERI	4.013387	1.825183	.463149	2.199	.0502
PCTWHITE	-26.931755	16.904067	-.458022	-1.593	.1394
PCTOTHER	-280.593383	132.070773	-.336358	-2.125	.0571
MOVEMENT	.281286	.206469	.263709	1.362	.2003
MEETING	-.290969	.485986	-.106205	-.599	.5615
DESIGN	1.213670	.721111	.785134	1.683	.1205
DAYLIGHT	-.274305	.411997	-.212932	-.666	.5193
COLOR	.170244	.288064	.119584	.591	.5665
LOCATION	-.550336	.617787	-.222499	-.891	.3921
INSTRUCT	-.249256	.320858	-.240275	-.777	.4536
OUTSIDE	-.267731	.197160	-.293118	-1.358	.2017

Variable(s) Entered on Step Number

1. INSLABS
2. PCTWHITE
3. OUTSIDE
4. COLOR
5. MEETING
6. MOVEMENT
7. PCTOTHER
8. AVEXPERI
9. LOCATION
10. INSTRUCT
11. DAYLIGHT
12. FREELUNC
13. DESIGN

Table 33: Model Summary

Multiple R	.90072
R Square	.81130
Adjusted R Square	.56599
Standard Error	8.79365

Table 34: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	13	3324.67584	255.74430	3.30726	.0326
Residual	10	773.28249	77.32825		

Table 35: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	30.123455	45.713489		.659	.5248
FREELUN	-.891653	.240838	-1.275724	-3.702	.0041
AVEXPERI	4.074097	1.903447	.470155	2.140	.0580
PCTWHITE	-31.638539	20.893710	-.538070	-1.514	.1609
PCTOTHER	-272.459389	138.710263	-.326608	-1.964	.0779
MOVEMENT	.259220	.221125	.243022	1.172	.2683
MEETING	-.279723	.506058	-.102100	-.553	.5926
DESIGN	1.123538	.780401	.726827	1.440	.1805
DAYLIGHT	-.155480	.514633	-.120692	-.302	.7688
COLOR	.166609	.299662	.117031	.556	.5904
LOCATION	-.533986	.643584	-.215889	-.830	.4261
INSTRUCT	-.184370	.368184	-.177726	-.501	.6274
OUTSIDE	-.279777	.207039	-.306306	-1.351	.2064
INSLABS	-.109326	.262366	-.099273	-.417	.6857

APPENDIX D

Results for the 5th Grade

Table 36: Model Summary

Multiple R	.9333313
R Square	.87073
Adjusted R Square	.83482
Standard Error	4.97539

Table 37: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	5	3001.37658	600.27532	24.24910	.0000
Residual	18	445.58175	24.75454		

Table 38: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	80.216228	13.779359		5.821	.0000
FREELUN	-.793814	.096673	-1.238356	-8.211	.0000
T4	.393331	.152252	.273036	2.583	.0187
AVEXPERI	1.820775	.742049	.229104	2.454	.0246
PCTWHITE	-18.580022	7.785094	-.344536	-2.387	.0282
PCTOTHER	-206.844964	81.185688	-.270356	-2.548	.0202

APPENDIX E

5th Grade Variables

Variable(s) Entered on Step Number
1. MOVEMENT
2. PCTWHITE
3. AVEXPERI
4. PCTOTHER
5. T4
6. FREELUNC

Table 39: Model Summary

Multiple R	.93320
R Square	.87087
Adjusted R Square	.82530
Standard Error	5.11687

Table 40: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	6	3001.85771	500.30962	19.10863	.0000
Residual	17	445.10062	26.18239		

Table 41: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	82.385578	21.375692		3.854	.0013
FREELUN	-.798556	.105397	-1.245754	-7.577	.0000
T4	.400788	.165963	.278212	2.415	.0273
AVEXPERI	1.824544	.763656	.229578	2.389	.0287
PCTWHITE	-18.857931	8.264774	-.349689	-2.282	.0357
PCTOTHER	-206.089481	83.680061	-.269368	-2.463	.0248
MOVEMENT	-.014004	.103304	-.014315	-.136	.8938

Variable(s) Entered on Step Number
1. MEETING
2. PCTOTHER
3. AVEXPERI
4. PCTWHITE
5. MOVEMENT
6. T4
7. FREELUNC

Table 42: Model Summary

Multiple R	.94984
R Square	.90220
Adjusted R Square	.85941
Standard Error	4.59023

Table 43: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	7	3109.83565	444.26224	21.08489	.0000
Residual	16	337.12269	21.07017		

Table 44: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	84.612619	19.200844		4.407	.0004
FREELUN	-.786244	.094705	-1.226546	-8.302	.0000
T4	.519993	.157919	.360960	3.293	.0046
AVEXPERI	1.750991	.685828	.220323	2.553	.0213
PCTWHITE	-14.420179	7.668915	-.267398	-1.880	.0784
PCTOTHER	-221.109035	75.360026	-.288999	-2.934	.0097
MOVEMENT	-6.02977E-04	.092861	-6.164E-04	-.006	.9949
MEETING	-.521945	.230564	-.207724	-2.264	.0378

Variable(s) Entered on Step Number

1. DESIGN
2. PCTWHITE
3. MOVEMENT
4. AVEXPERI
5. PCTOTHER
6. MEETING
7. T4
8. FREELUNC

Table 45: Model Summary

Multiple R	.95504
R Square	.91210
Adjusted R Square	.86521
Standard Error	4.49445

Table 46: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	8	3143.95707	392.99463	19.45510	.0000
Residual	15	303.00126	20.20008		

Table 47: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	79.243241	19.248790		4.117	.0009
FREELUN	-.781025	.092816	-1.218404	-8.415	.0000
T4	.545422	.155857	.378612	3.500	.0032
AVEXPERI	2.012520	.701019	.253230	2.871	.0117
PCTWHITE	-14.401472	7.508917	-.267051	-1.918	.0744
PCTOTHER	-245.597343	76.155291	-.321007	-3.225	.0057
MOVEMENT	-.018716	.091985	-.019131	-.203	.8415
MEETING	-.696951	.262861	-.277373	-2.651	.0181
DESIGN	.196330	.151060	.138483	1.300	.2133

Variable(s) Entered on Step Number

1. DAYLIGHT
2. PCTWHITE
3. AVEXPERI
4. PCTOTHER
5. MEETING
6. MOVEMENT
7. T4
8. DESIGN
9. FREELUNC

Table 48: Model Summary

Multiple R	.96460
R Square	.93045
Adjusted R Square	.88574
Standard Error	4.13805

Table 49: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	9	3207.22992	356.35888	20.81115	.0000
Residual	14	239.72842	17.12346		

Table 50: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	88.636144	18.383694		4.821	.0003
FREELUN	-.780174	.085457	-1.217077	-9.129	.0000
T4	.545802	.143498	.378875	3.804	.0019
AVEXPERI	1.757816	.658890	.221182	2.668	.0184
PCTWHITE	-14.209152	6.914200	-.263485	-2.055	.0590
PCTOTHER	-258.227957	70.423542	-.337515	-3.667	.0025
MOVEMENT	-.092577	.093000	-.094633	-.995	.3364
MEETING	-.604091	.246791	-.240416	-2.448	.0282
DESIGN	-.041651	.186201	-.029379	-.224	.8262
DAYLIGHT	.271017	.140988	.229387	1.922	.0752

Variable(s) Entered on Step Number

1. COLOR
2. PCTOTHER
3. MEETING
4. FREELUNC
5. MOVEMENT
6. AVEXPERI
7. DAYLIGHT
8. T4
9. DESIGN
10. PCTWHITE

Table 51: Model Summary

Multiple R	.96533
R Square	.93186
Adjusted R Square	.87944
Standard Error	4.25073

Table 52: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	10	3212.06540	321.20654	17.77697	.0000
Residual	13	234.89293	18.06869		

Table 53: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	87.384524	19.038634		4.590	.0005
FREELUN	-.796020	.092975	-1.241798	-8.562	.0000
T4	.581772	.162982	.403844	3.570	.0034
AVEXPERI	1.967609	.789028	.247579	2.494	.0269
PCTWHITE	-15.404941	7.469151	-.285659	-2.062	.0597
PCTOTHER	-259.764145	72.402074	-.339523	-3.588	.0033
MOVEMENT	-.110863	.101862	-.113326	-1.088	.2962
MEETING	-.595291	.254081	-.236914	-2.343	.0357
DESIGN	-.056173	.193320	-.039622	-.291	.7760
DAYLIGHT	.263928	.145474	.223387	1.814	.0928
COLOR	.069015	.133410	.052858	.517	.6136

Variable(s) Entered on Step Number

1. LOCATION
2. PCTWHITE
3. MOVEMENT
4. AVEXPERI
5. PCTOTHER
6. MEETING
7. COLOR
8. DAYLIGHT
9. T4
10. FREELUNC
11. DESIGN

Table 54: Model Summary

Multiple R	.96580
R Square	.93278
Adjusted R Square	.87116
Standard Error	4.39422

Table 55: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	11	3215.24781	292.29526	15.13761	.0000
Residual	12	231.71052	19.30921		

Table 56: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	86.540237	19.790915		4.373	.0009
FREELUN	-.795008	.096146	-1.240219	-8.269	.0000
T4	.590047	.169712	.409589	3.477	.0046
AVEXPERI	2.087511	.867489	.262666	2.406	.0331
PCTWHITE	-15.840733	7.795558	-.293740	-2.032	.0649
PCTOTHER	-262.071251	75.061672	-.342539	-3.491	.0045
MOVEMENT	-.119836	.107595	-.122499	-1.114	.2872
MEETING	-.593822	.262683	-.236330	-2.261	.0432
DESIGN	.005196	.250578	.003665	.021	.9838
DAYLIGHT	.266247	.150494	.225349	1.769	.1023
COLOR	.081572	.141339	.062476	.577	.5745
LOCATION	-.116672	.287390	-.051432	-.406	.6919

Variable(s) Entered on Step Number

1. INSTRUCT
2. MOVEMENT
3. LOCATION
4. PCTOTHER
5. AVEXPERI
6. FREELUNC
7. COLOR
8. MEETING
9. DAYLIGHT
10. T4
11. PCTWHITE
12. DESIGN

Table 57: Model Summary

Multiple R	.96833
R Square	.93767
Adjusted R Square	.86967
Standard Error	4.41951

Table 58: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	12	3232.10565	269.34214	13.78974	.0001
Residual	11	214.85269	19.53206		

Table 59: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	85.970033	19.914254		4.317	.0012
FREELUN	-.770034	.100367	-1.201259	-7.672	.0000
T4	.588015	.170703	.408178	3.445	.0055
AVEXPERI	-12.005303	.872889	.259545	2.363	.0376
PCTWHITE	-12.005303	8.860937	-.222618	-1.355	.2026
PCTOTHER	-245.929781	77.467152	-.321441	-3.175	.0088
MOVEMENT	-.096897	.110996	-.099050	-.873	.4013
MEETING	-.589748	.264231	-.234708	-2.232	.0474
DESIGN	.259608	.372165	.183116	.698	.4999
DAYLIGHT	.146168	.199038	.123715	.734	.4781
COLOR	.110342	.145487	.084510	.758	.4641
LOCATION	-.196199	.301453	-.086489	-.651	.5285
INSTRUCTION	-.155135	.166987	-.163056	-.929	.3728

Variable(s) Entered on Step Number

1. OUTSIDE
2. PCTOTHER
3. AVEXPERI
4. MEETING
5. PCTWHITE
6. MOVEMENT
7. DAYLIGHT
8. COLOR
9. INSTRUCT
10. LOCATION
11. T4
12. FREELUNC
13. DESIGN

Table 60: Model Summary

Multiple R	.97158
R Square	.94396
Adjusted R Square	.87111
Standard Error	4.39497

Table 61: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	13	3253.80090	250.29238	12.95795	.0001
Residual	10	193.15744	19.31574		

Table 62: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	73.285495	23.139487		3.167	.0100
FREELUN	-.800571	.103885	-1.248897	-7.706	.0000
T4	.452335	.212619	.313994	2.127	.0593
AVEXPERI	2.473936	.950821	.311289	2.602	.0264
PCTWHITE	-11.898807	8.812306	-.220644	-1.350	.2067
PCTOTHER	-216.015193	82.045289	-.282341	-2.633	.0250
MOVEMENT	-.016842	.133752	-.017216	-.126	.9023
MEETING	-.533304	.268107	-.212245	-1.989	.0747
DESIGN	.326615	.375460	.230380	.870	.4047
DAYLIGHT	.040473	.221638	.034256	.183	.8588
COLOR	.157551	.151381	.120667	1.041	.3225
LOCATION	-.010586	.347190	-.004667	-.030	.9763
INSTRUCTION	-.177110	.167349	-.186153	-1.058	.3148
OUTSIDE	-.136010	.128335	-.162361	-1.060	.3142

Variable(s) Entered on Step Number

1. INSLABS
2. PCTWHITE
3. T4
4. LOCATION
5. AVEXPERI
6. MOVEMENT
7. MEETING
8. PCTOTHER
9. COLOR
10. INSTRUCT
11. DAYLIGHT
12. OUTSIDE
13. FREELUNC
14. DESIGN

Table 63: Model Summary

Multiple R	.98362
R Square	.96751
Adjusted R Square	.91698
Standard Error	3.52727

Table 64: Analysis of Variance

	Degrees of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	14	3334.98351	238.21311	19.14643	.0001
Residual	9	111.97483	12.44165		

Table 65: Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	SE B	Beta	t	Sig t
(Constant)	67.452311	18.710942		3.605	.0057
FREELUN	-.659111	.100091	-1.028219	-6.585	.0001
T4	.670095	.190751	.465155	3.513	.0066
AVEXPERI	2.374617	.764091	.298792	3.108	.0126
PCTWHITE	.327279	8.539810	.006069	.038	.9703
PCTOTHER	-284.410253	71.082730	-.371737	-4.001	.0031
MOVEMENT	-.037971	.107663	-.038815	-.353	.7324
MEETING	-.656355	.220501	-.261217	-2.977	.0155
DESIGN	.550794	.313853	.388506	1.755	.1132
DAYLIGHT	-.227487	.206508	-.192543	-1.102	.2992
COLOR	.190554	.122179	.145944	1.560	.1533
LOCATION	-.190868	.287444	-.084139	-.664	.5233
INSTRUCTION	-.340936	.148836	-.358345	-2.291	.0477
OUTSIDE	-.023758	.111981	-.028361	-.212	.8367
INSLABS	.300504	.117641	.297526	2.554	.0310

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